AUGUST, 1951
Vol. 7 --- No. 4

Lubrication ENGINEERING

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

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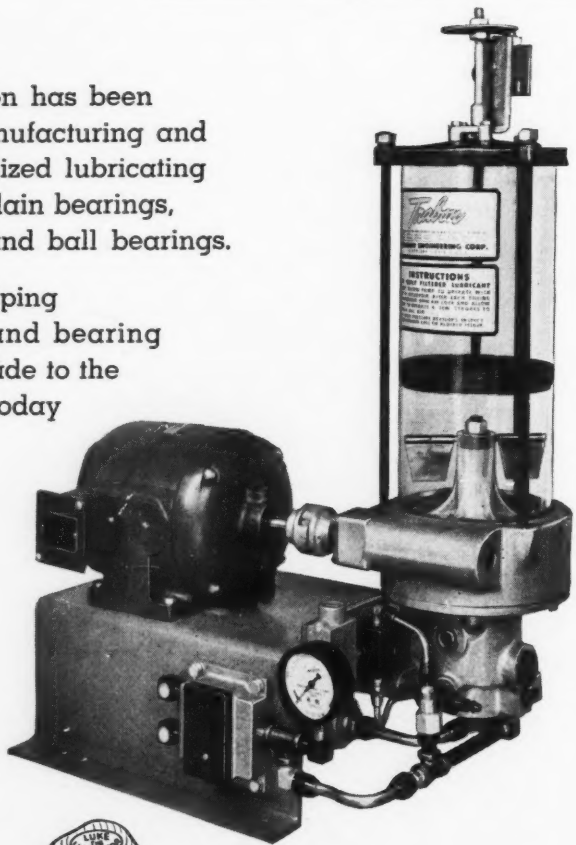

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Lubrication Engineering

VOL. 7 AUGUST, 1951 No. 4

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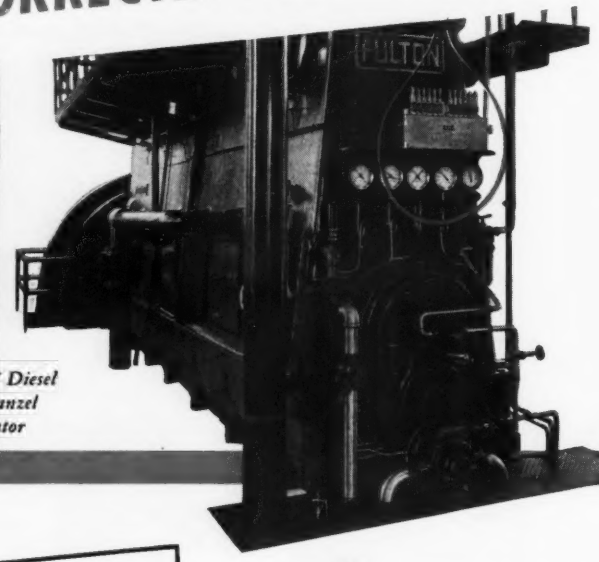

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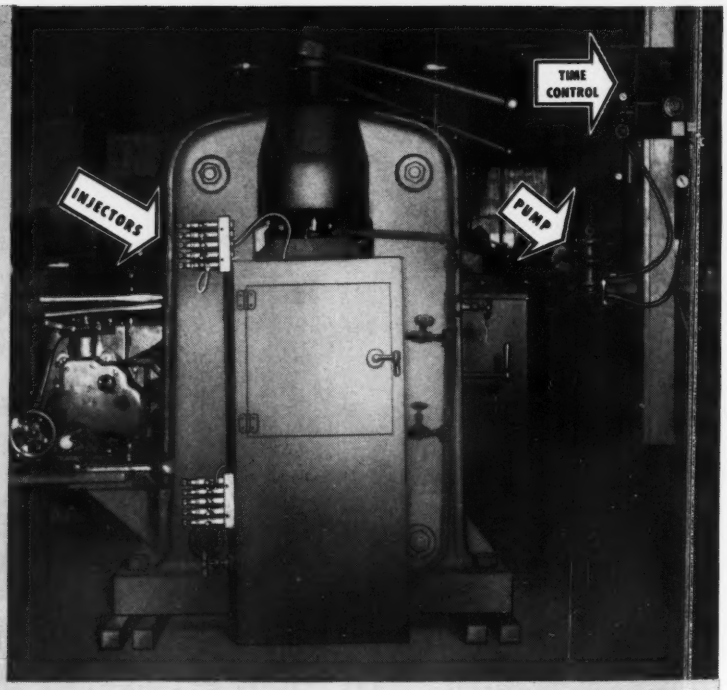


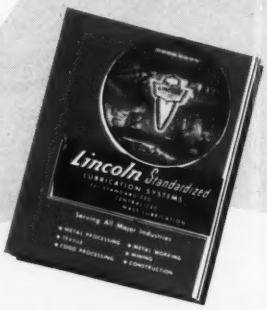
Lincoln Centralized Lubrication System as installed on Farrel-Birmingham 16" x 24" Brass Rolling Mills at The Miller Company, Meriden, Conn.

"Our Lincoln Centro-Matic* Lubricating System serves a dual purpose. It is economical from a lubrication standpoint, because of the uniform distribution of the necessary lubricant to critical positions on heavy machinery, without waste. And because the necessary lubricant is at those critical points, the System is economical from our mill operation standpoint.

"Mill shutdown for manual lubrication has been eliminated. Development of heat in the mill, because of friction on the Bronze bearing, has been reduced to such a minimum that extra operations for Cold-Rolling reduction have been virtually eliminated.

"The heavy Bronze bearing life has been increased from two months to two and one-half years, and power consumption reduced 30%!"

F. R. Slagle, Vice Pres.
The Miller Company, Meriden, Connecticut



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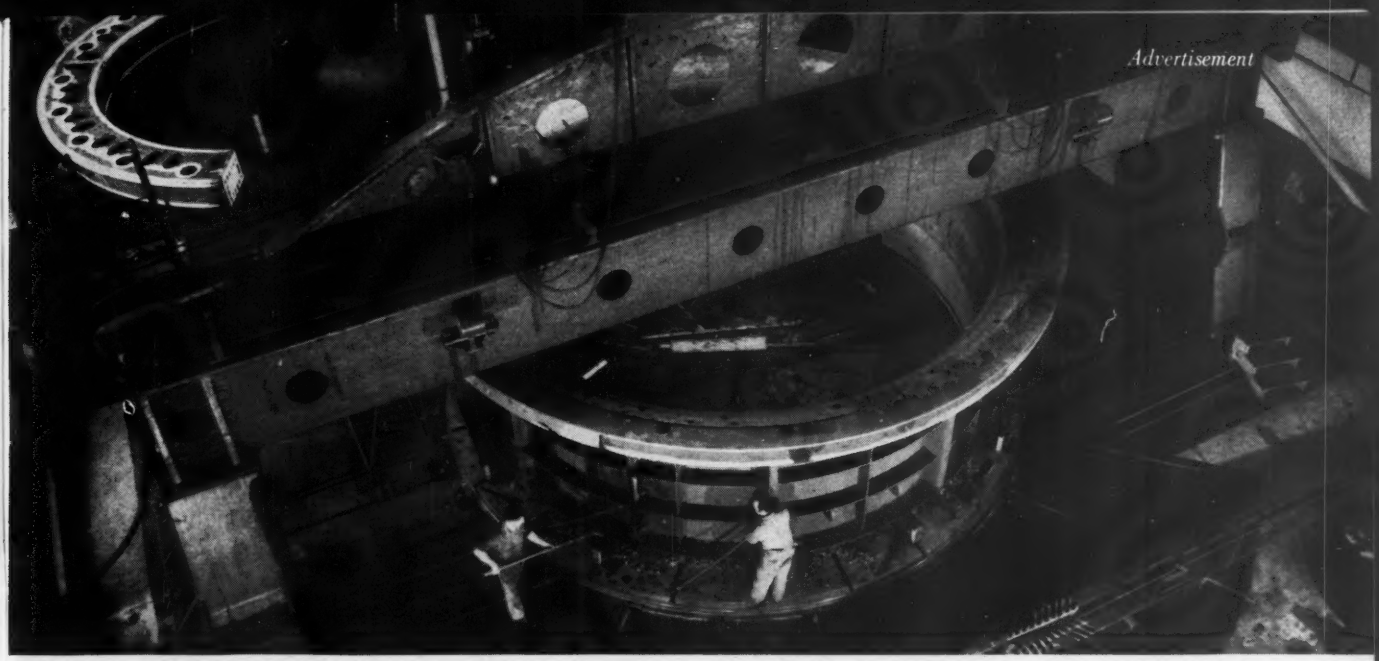
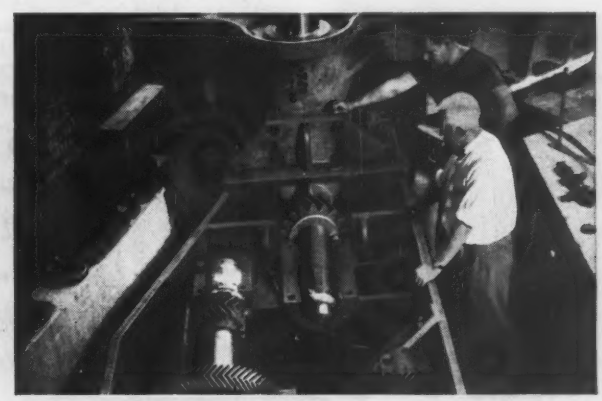


$400,000 VERTICAL BORING MILL, one of the world's largest, bores, turns and faces hydraulic turbine parts. Sunoco Way Lubricant, approved by 39 machine tool builders, was selected by the design engineers to prevent stick-slip with resultant scoring of ways and slides. Even under the weight of work as heavy as 75 tons, Sunoco Way Lubricant has never squeezed out.

TURBINE PARTS 62 FEET IN DIAMETER MACHINED BY HUGE VERTICAL BORING MILL

This mill was installed eight months ago by S. Morgan Smith, well-known hydraulic turbine manufacturer. Without alterations, it can take work up to 22 feet high with a maximum swing of 42 feet between housings. By removing the housings and adding a head to the face plate, it can be modified to handle parts 62 feet in diameter. Sunoco Way Lubricant, specified for the ways and rails by the design engineers, has been used exclusively. The mill accommodates work that weighs as much as 75 tons. No jump or stick-slip has ever marred a finish or impaired accuracy. The ways and rails remain like new. This is typical of the performance that has won the endorsement of 39 machine tool builders for Sunoco Way Lubricant. For an informative booklet and sample, write on your business letterhead to Sun Oil Company, Department LE-8, Phila. 3, Pa.

ELECTRONICALLY CONTROLLED CUTTING TOOLS machine a turbine discharge ring 9' high, 27' 8" dia., 21' 8" bore. Sunoco Way Lubricant keeps rails free of rust and corrosion. Starting up after week-end shutdowns, tables and other parts move freely on the ways and slides without jump or stick-slip.



THE SYNCHRONOUS GEAR DRIVE, controlling table speeds from .094 to 6.045 rpm., is pressure-fed with another Sun "Job Proved" product—Sunep. This extreme pressure lubricant is exceptionally stable, minimizes wear, gives long-time protection to very heavily loaded teeth in many types of gear boxes.

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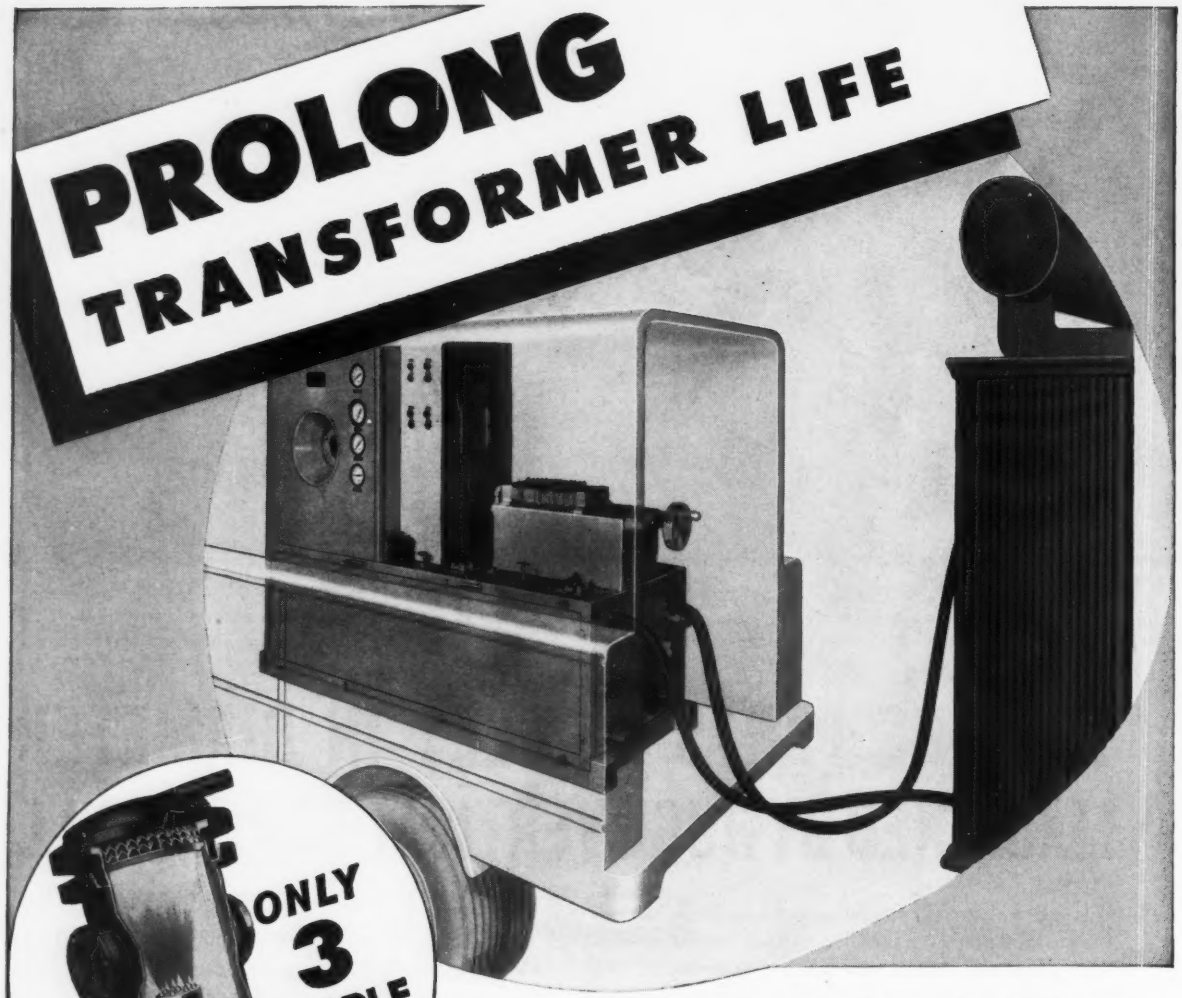

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2. Volatile contaminants are then completely removed by high vacuum.
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LOW COST—HIGH DIELECTRIC

The average cost of preventive maintenance was less than one cent per gallon per year. Oil dielectric was kept above 35 k.v. with a single pass, and the water soluble acid content was nearly zero.

NOW is the time to reduce your maintenance costs!
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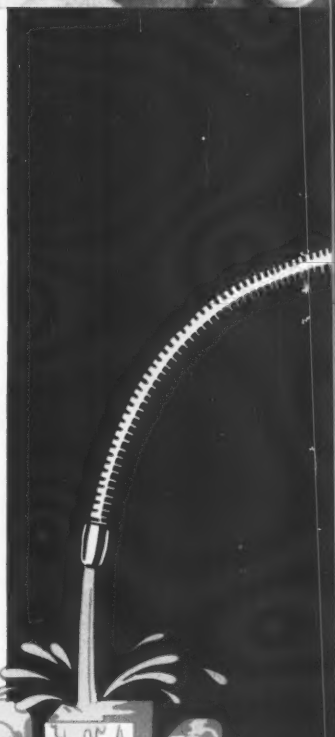
°Trade Mark Reg. U.S. Pat. Off.



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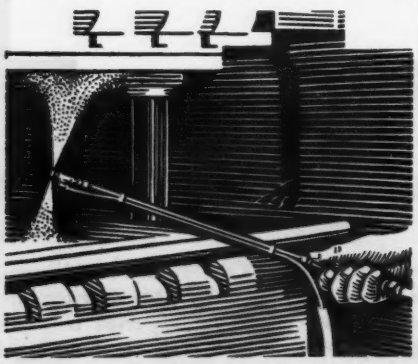
NO SMOKE... NO FUMES in Hot Forging with... "dag" Colloidal Graphite



"Dag" colloidal graphite dispersed in water eliminates smoke and fumes in hot forging operations . . . greatly improves working conditions. The lubricating properties of colloidal graphite are superior, too, giving increased production . . . reduced die wear . . . better finish . . . and usually a saving in steel stock.

The uses of **"dag"** colloidal graphite for hot forging operations are fully explained in a specially prepared article entitled "Forging Die Lubrication". Copies are available without obligation. Write today to Acheson Colloids Corporation, Port Huron, Michigan, for Bulletin #750-12H.

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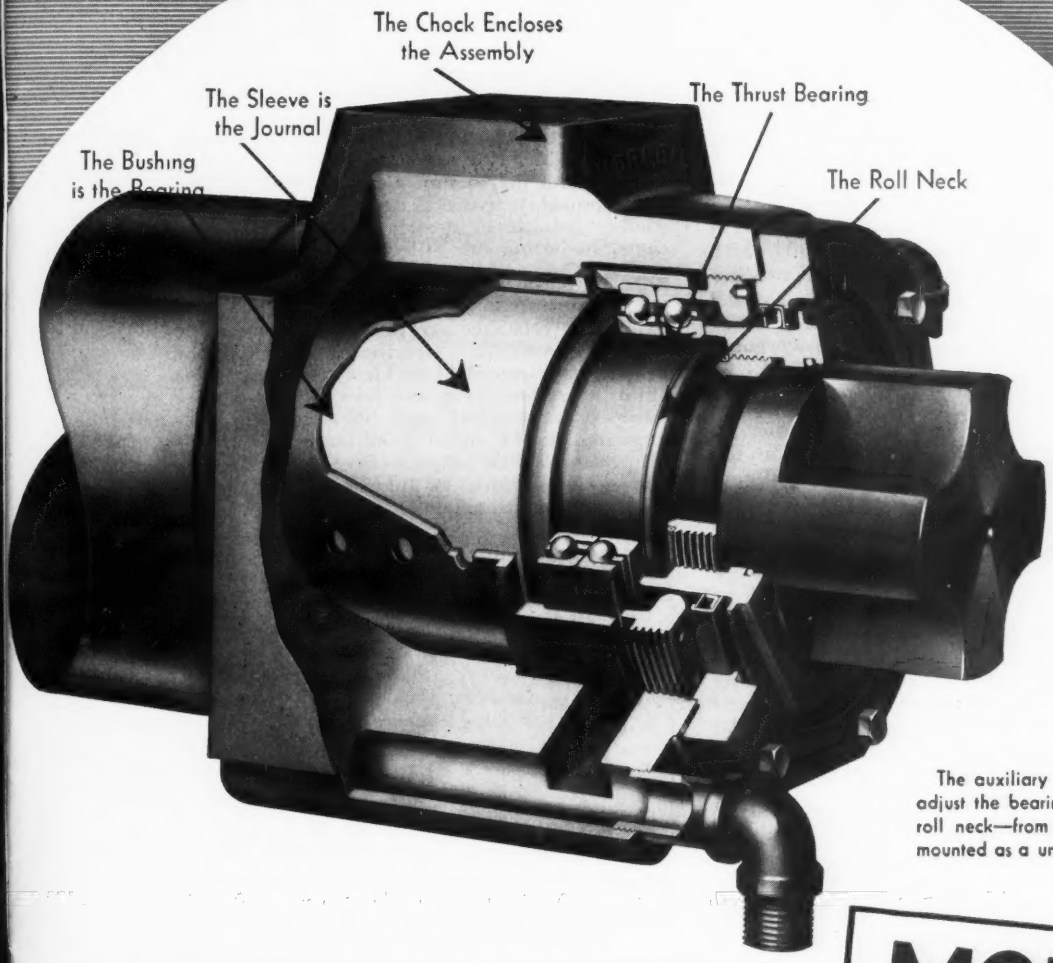

The auxiliary parts serve to seal and adjust the bearing and secure it to the roll neck—from which it is easily dismounted as a unit.

How Simple can a bearing be?

One reason for the high efficiency of Morgoils . . . and their low operating and maintenance costs . . . is their extreme simplicity of design. Each part is there for a purpose . . . and each contributes to make Morgoils the most widely accepted roll neck bearings.

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Silicone Notes

ON LUBRICATION

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FILE SILICONE LUBRICANTS

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DOW CORNING CORPORATION
Midland, Michigan

DOW CORNING 44 GREASE

791 HOURS AT 400°F. plus 2033 hours of operation at 300°F. were ticked off before we reached an end point in testing bearings lubricated with Dow Corning 44 Silicone Grease. We used heat-treated, steel retainer bearings operating at 1750 rpm under a spring load of 150 pounds. After 250 eight-hour days at 300°F., we pushed the temperature up to 400. 791 hours later the bearing failed. That's at least 10 times the maximum life recorded for any organic grease tested at 400°F.

AFTER 754 HOURS at 390, 365 and 330°F. respectively, the life testing of Dow Corning 44 Grease in 3 similar bearings operating at the same speed under the same load was discontinued. Only the 390° bearing showed sign of failure. Under the same conditions, other bearings were operated at 385°F. for 814 hours and at 390°F. for 774 hours. The bearings were just beginning to be noisy.

RESULTS OF OUR LIFE TESTING at 350-400°F. have been confirmed by independent investigators. We feel justified, therefore, in raising the maximum operating temperature suggested for Dow Corning 44 Silicone Grease from 350 to 400°F. Maximum speed factor (mm. bore x rpm) remains at 150,000-225,000.

ANNEALING OVENS AT 1400°F. are located only 2 feet from bearings on motor directly coupled to forced draft fans. In spite of frequent relubrication with organic greases these bearings had a service life of about 6 months. The electrical foreman finally installed bearings prelubricated with Dow Corning 44 Grease. These bearings have never been relubricated and they are still in service after about 2 years of operation.

DOW CORNING SILICONE OILS

METAL COMBINATIONS now commonly used in bearings were developed to give maximum service with conventional lubricants. They are the result of years of Edisonian research. Yet many people assume that the lubricant is incidental; expect a synthetic lubricant to perform equally well between metals carefully selected for use with petroleum oils of radically different chemical structure. That's a fallacy that may lead to trouble in the use of synthetic lubricants, including our silicone oils and greases.

RELATIVELY CONSTANT VISCOSITY over a wide temperature span, exceptional heat stability and oxidation resistance are properties peculiar to our silicone fluids. And those are among the properties required of an ideal lubricant. The ability to reduce wear and friction is the other basic property and that depends in large measure on the metal combinations. Here's some data on the relative effectiveness of various silicone fluids as lubricants for various metal combinations.

METAL COMBINATION	*Dow Corning 200*	*Dow Corning 550*	*Dow Corning 710*
Cast iron—bronze	Good	Good	Good
Cast iron—steel	Poor	Poor	Poor
Bronze—nylon	Good	Good	Good
Steel—aluminum	Poor	Poor	Poor
Steel—babbitt	Good	Poor	Poor
Steel—bronze	Good	Good	Poor
Steel—cadmium	Good	Good	Good
Steel—chrome	VARIABLE RESULTS		
Steel—nylon	Good	Good	Good
Steel—steel	Poor	Poor	Poor
Steel—zinc	Good	Good	Good

These data were obtained with a Falex lubricant test machine under boundary or extreme pressure conditions. They are presented here only as a guide in selecting metal combinations to give maximum life with various Dow Corning Silicone Fluids. Careful breaking-in of bearing surfaces may be required.

TWO YEARS vs. 36 HOURS. That's the relative life of a few drops of Dow Corning 710 Fluid compared with any other lubricant tested in a clock motor fully exposed to the atmosphere.

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

DOW CORNING SILICONES

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CANADA: Fiberglas Canada Ltd., 1200 Bay Street, Toronto, Ontario

ENGLAND: Midland Silicones Ltd., 49 Park Lane, London, W. 1

Lube Lines

Rust Prevention

H. R. Baker and W. A. Zisman, reported in the June issue of LUBRICATION ENGINEERING on the progress of post-war research on rust inhibitors, in an article entitled "Liquid and Vapor Corrosion Inhibitors." This was an able and scientific discussion of rust prevention.

In this issue (page 174) we present the practical approach to this same subject by H. B. Carpenter. Uses, applications and descriptions of various types of petroleum base rust preventives are covered.

We have endeavored, through the publication of these two papers, to give our readers scientific and research data, together with actual field experience.

Papers for Publication

An indication of the growing world interest in lubrication is evidenced by the increasing number of foreign manuscripts offered to this JOURNAL for publication.

To expedite the work of our Editorial and Reviewing Committees, it has become necessary to announce that all papers, in order to receive consideration, must be submitted in the English language.

It is gratifying to note the unity of thought and purpose, represented by our friends overseas, in aiding in the further dissemination of lubrication information. We welcome their continued interest and support.

Editorially Speaking

Our readers are well aware of the basic ideas and aims which led to the formation of ASLE. We shall make no further comment here.

However, we do feel that you will be interested to learn of the increase in editorial mention re: the lubrication engineer, in those publications serving the mechanical, engineering, and allied fields.

We refer specifically to the "President's Page" by Howard Cooper, President of N.L.G.I., under the title of "The Lubrication Engineer," appearing in the May issue of *The Institute Spokesman,* that excellent publication representing the grease manufacturing industry.

Mr. Cooper ably defines the status of the lubrication engineer in modern industry and we quote:

"The N.L.G.I. salutes the lubrication engineer, with appreciation for the contributions he has made and is making toward the development of finer lubricants, and to improvement in effectiveness, efficiency and economy in the lubrication of mechanical equipment."

Your further attention is called to the June, 1951 issue of *Power,* page 71, to an editorial entitled, "Meet the Lubrication Engineer."

Again we find stressed the importance of the men engaged in lubrication practice. In summing up, we quote:

"Lubrication is becoming a managed function. The lubrication engineer is taking over. His men are trained technicians, not mere 'oilers.'

"All this would be a sound way to save money even with the limited machine demands and lubrication of a decade ago. It's much more important today with bearing loads, speeds and temperatures climbing. And oils and greases are more complex; many additives now cope with new and some old conditions.

"Yes, it will pay you to set up a lube plan in your plant that fits into today's engineered and managed lubrication picture. And don't fail to get the right man to run it!"

The incidents cited above, coupled with the increase in educational activities in this field, are indicative of the recognition now being accorded the lubrication engineering profession.

M.I.T. Summer Course

The recently completed Lubrication Engineering Course, the first of its kind ever offered to industry, was an outstanding success. The program, a photograph of the participating group and other pertinent details will be found on page 192 of this issue.

Tentative preparations are under way for similar group instruction in other educational institutions, under the sponsorship of ASLE. Announcements of future plans, will be published on this page, as rapidly as developments permit.

NUMBER 5

HYDRAULIC FLUIDS SIMPLIFIED*

by C. R. Schmitt
Manager, Lubrication Sales Dept.,
E. F. Houghton & Co.
Philadelphia 33, Pa.

Mr. Schmitt graduated from Case Institute of Technology in 1934 with an M.E. degree.
He became associated with the Lubrizol Corporation and engaged in the promotion and sale of additives for industrial and automotive lubricants until 1942. At this time the Retail Division of Lubrizol Corporation was merged with that of E. F. Houghton & Co., and Mr. Schmitt joined Houghton. He was transferred from Philadelphia to Cleveland, remaining in Cleveland as Manager of the Lubrication Dept., Central Division, until April, 1951.
He is now manager of the Lubrication Sales Department of Houghton with headquarters in the home office in Philadelphia.
Mr. Schmitt is an active member of ASLE, having served in several official capacities with the Cleveland Section of the Society.

In arranging material for this article, I endeavored to bear in mind the underlying necessity of keeping it as non-technical as possible. In making this statement, I do not wish to create the impression that technical subjects are not acceptable. It is simply that I believe the subject of Hydraulic Fluids in general can best be covered by presenting ideas and facts rather than by the use of involved test results, graphs, charts, etc.

The word "Hydraulic" is defined as "pertaining to hydraulics, involving the movement of water, or force exerted by water." It is taken from the Greek words "Hydôr" meaning "water" and "Aulos" meaning "pipe." Today, of course, hydraulics applies to many other types of fluids besides water, chief among which is petroleum oil.

The principle of the utilization of fluids under pressure for mechanical motion is by no means of modern origin. We have only to read accounts of water powered machinery of the ancients to realize that, even then, its usage was understood, if somewhat crudely. The essential difference between today's hydraulics and those of the ancients lies in the complexity and severity of the modern circuit.

No truer fact was ever stated than that a chain is only as strong as its weakest link. This truism can be very aptly applied to the satisfactory performance of the hydraulic fluid in the hydraulic machine too.

The hydraulic fluid, or, since we are principally interested in petroleum oil, let us refer to it as hydraulic *oil*, has several functions to perform in the modern circuit.

1. It must protect the system against rust and corrosion.
2. It must adequately lubricate the hydraulic pump.
3. It must retain its original characteristics over a long period of service.
4. It must be capable of transmitting hydraulic power despite the presence of varying amounts of common contaminants.

*Sponsored by ASLE Technical Committee on Lubrication Economics.

At the recent ASLE Convention in Detroit, Mr. M. A. Hayden, Vickers, Inc., presented a paper entitled: "The Main-Ten-Ends in Hydraulic Maintenance." In his paper, Mr. Hayden makes the statement: "If there is still any doubt about the user's control of maintenance problems, here are the results of a recent analysis of service calls to customers' plants on hydraulic equipment, and of unit repairs. It shows the following approximate distribution of causes for such service:

70% due to improper condition of the hydraulic oil.
10% due to the improper diagnosis of the trouble or lack of "know how" in making repairs.
10% due to mechanical failures such as bearing failures from misalignment, seal failure due to dirt, etc.
5% due to operating units beyond recommended limits on speed, pressure or volume.
5% due to miscellaneous unclassified causes ranging from excessive packing friction on hydraulic rams to chatter resulting from inadequate way lubrication."

This analysis demonstrates emphatically the importance of the proper hydraulic fluid and its maintenance in the field. There are three things to consider in this respect:

1. The oil as received before service.
2. Maintenance of the oil during service.
3. Reconditioning of the oil following service.

Let us consider the first item, the oil as received before service. Unless this fluid is suitable for the application, troubles of several varieties can be expected to develop. For example, if the fluid tends to thin out excessively due to temperature rise during usage (low viscosity index), pump noise may develop with accompanying wear of pump parts. Such a condition can also result in pump slippage, pressure loss and sluggishness in machine functions.

Another example of trouble can occur from fluid breakdown. It may change chemically due to oxidation and form gummy residues which result in the retarding or complete halting of pilot and reversing valve actions.

This slows up production and, unless the circuit is carefully designed, can result in serious damage to both machine and work being produced.

These are but two general examples of the results of fluid breakdown in a hydraulic system. The task confronting the oil industry is to develop and market fluids capable of maintaining their original properties for prolonged service periods even under adverse operating conditions.

Secondary to this, but not less important, is the task of convincing the hydraulic machine user of the profit to him in terms of maintenance of production and lowering overhead costs, through the use of such fluids even though their first cost may be slightly higher.

In order to study the situation and arrive at a possible solution, let us first consider the essential properties desired in a hydraulic fluid:

1. Viscosity
2. Lubricity
3. Stability

You will note that I have listed only three requisites. There are other *desirable* properties worthy of mention but, for the sake of simplicity and getting down to fundamentals, let us, for the time being, consider only the three factors mentioned.

1. Viscosity

Regardless of what we think of the various superior properties of available hydraulic fluids, we must admit that, if the fluid does not flow properly through the system under pressure from the pump, it cannot be considered for use. It is analogous to considering the relative importance of food, drink, rest, clothing and shelter for the maintenance of life. While these are important, they are not comparable to the need for air, since lack of oxygen, even for a few moments, would result in certain death.

Viscosity, too, determines quickly whether a hydraulic circuit will operate or "die" due to lack of proper circulation. Other items, therefore, become secondary in importance.

It is essential to consult the oil supplier, or the machine builder, for information as to the correct viscosity of the hydraulic fluid to be used.

2. Lubricity

After the matter of fluidity is settled, comes the item of proper lubrication. Today's pumps are precision instruments of varying degrees depending upon the use to which they are put. Their rubbing surfaces are ground and lapped so that fluid leakage and loss in efficiency is held to a minimum. To protect these expensive surfaces, the fluid used must be a good lubricant. It is my belief, after considerable field observation, that they should be better than "good." Synthetic film strength and lubricity addition agents should be used to fortify the natural properties of the fluid.

Such so-called "EP" additives are now used and have demonstrated their stability and effectiveness over a period of years in many different kinds of service.

3. Stability

This property has been the most controversial subject, up until recently, of any to be discussed. Through the years, it has been alternately exalted and condemned. The reason for the fluctuations in opinion has been the means used to arrive at superior stability for petroleum fluids. Chemical additives used for this purpose are many and varied. Some of them have been used without careful consideration of *all* properties, resulting in failures other than those caused by oil breakdown. For example, a hydraulic oil was placed on the general market a few years ago which was supposed to incorporate high film strength with exceptionally great stability. It is quite possible that it did have the properties claimed and might still be available today had it not been for the fact that it clogged orifices, due to a gradual precipitation of part of the additive used. The oil was withdrawn from the market, additives in general were ostracized, and the cry—"Don't interfere with Nature" again underscored the sales efforts of most refiners. The pump manufacturers climbed down off the additive bandwagon and, from then on, were hard to convince. This, despite the satisfactory service record of other additive treated hydraulic oils extending back fifteen years or more.

Today, however, the picture has reversed, this time, it seems, permanently. Most pump and hydraulic machinery builders agree that additive-containing oils are beneficial and superior to straight mineral oils. With such agreement existing, there is every reason to expect hydraulic oil quality to keep pace with the ever accelerating design tempo of the hydraulic mechanism.

Before we leave the subject of the *new* oil properties completely, let us consider briefly some desirable qualities which are obtainable in certain hydraulic oils.

(A) Rust Protection

This feature is obtained through the use of suitable rust inhibitors which "plate out" on metal surfaces and thus protect them by insulating them against the action of moisture, mild acids, etc.

(B) Gum Solvency

Through the action of certain types of additives, the oil is given greater power to hold gums and resins in solution. Therefore, since even the finest oil will deteriorate in time, the products of such deterioration will be dissolved in the oil and prevented from dropping out onto valve and pump surfaces. For this reason, an oil having greater solvent power can be kept in service longer than one which permits such resinous compounds to drop out and interfere with proper machine action.

(C) Foam Resistence

Some oils tend to foam excessively during service if the return line to the reservoir is not kept below the surface of the oil at all times. This often happens when the oil supply is not replenished properly and the oil level drops. If the design is such that turbulence and mixture with air is unavoidable, anti-foam additives are available which, in as small proportions as one part to 100,000 parts of oil, will completely eliminate foaming.

(D) Miscellaneous Properties

Other properties, such as the following, associate

themselves with one of the three basic requirements already discussed; namely, Viscosity, Lubricity and Stability.

1. Viscosity Index

Ability to maintain rated pressures and speeds throughout possible shop temperature changes. The higher the Viscosity Index, the more constant the body of the oil under temperature change. (Viscosity.)

2. Pour Point

Pump manufacturers usually recommend that the pour point be 15 F. to 20 F. below the lowest anticipated operating temperature. This is important to prevent starving of the pump on the suction side, commonly referred to as cavitation. (Viscosity.)

3. Neutralization (Acid) Number

This term formerly was used to predict the corrosive tendencies of a hydraulic oil. Today, however, so many things affect the magnitude of this number that it is seldom depended upon for this purpose. Instead, actual tests are run using the metals encountered in service to determine any corrosive effect likely to be had.

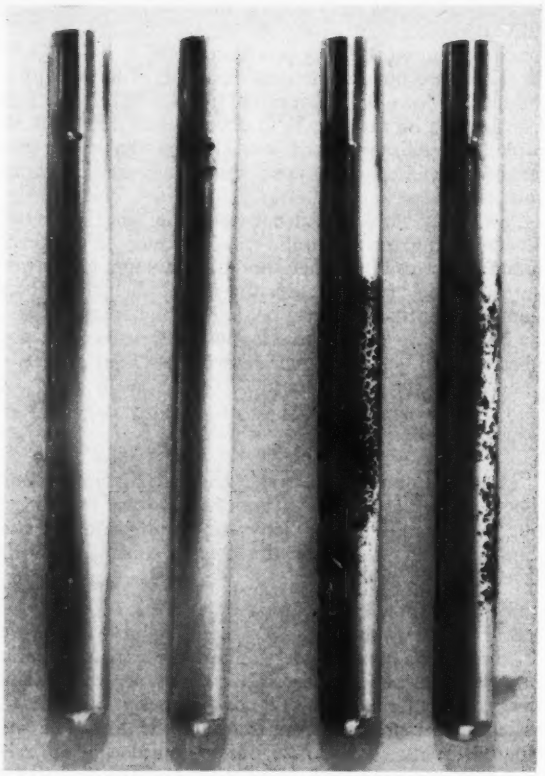
Neutralization Number, however, is often used as a rule of thumb test to determine the useful life of a hydraulic oil in service. Limiting values ranging from 0.5 to 1.0 have been used successfully to set up drain periods in the field. (Stability.)

4. Demulsibility

Because of the ever-present possibility of water contamination from condensation, particularly in humid climates, the oil must separate from it quickly. Otherwise, oil-water emulsions will form causing sluggish oil motion and reduction of lubriating effectiveness. Such oil-water emulsions are further aggravated when solids of any kind are present in the form of dirt, dust, metallic particles, plastic dust, lint, etc. Most of us at one time or another have seen this form of sludge inside automobile crankcases or valve chambers. The only difference is the black color imparted by soot produced through combustion in the engine. Hydraulic oil emulsions are usually brownish colored except where excessive heat has developed to turn them black.

We do not usually consider physical properties such as Gravity, Color, Flash, and Fire Points and Carbon Residue to be of importance in application of hydraulic oils. These properties originated in connection with crankcase oils but are of little or no significance in hydraulics.

In the foregoing, you have had a kind of Cook's Tour through the important points to be considered in selecting a hydraulic oil for your requirement. Of course, under each heading, there are other things to be discussed which are not within the scope of this paper. Furthermore, many of these points are clarified only on the basis of past experience and knowledge of the behavior of petroleum and petroleum-synthetic additive combinations. For this reason, it is well to select your oil supplier on the basis of confidence in his judgment and experience and permit him to guide you in the solution of hydraulic oil problems.



Test Pins—"Result of A.S.T.M. Test (D665-44T) showing pins at right corroded after run in straight petroleum oil. The pins illustrated at the left are unharmed after same time in rust inhibited oil."

Maintenance of System

Once the proper type and grade of fluid for the hydraulic system has been obtained, it becomes necessary to decide upon ways and methods for prevention of contamination. Since the oil reservoir level is constantly raising and lowering due to variation in the volume of oil flowing through the system, air is being drawn in and expelled at intervals. This breathing effect results in the possibility of contaminating the oil with whatever foreign particles form part of the surrounding atmosphere. If we are concerned with plastic moulding equipment, we shall very likely discover contamination in the form of plastic dust. If die casting machines are used, zinc or aluminum particles will probably be found in the oil reservoir.

Inlet Filters, Strainers

Having established the probability of outside contamination, prevention through the use of breather filters or strainers is in order. Such strainers are available either as original equipment or from any of the well-known filter or dispensing equipment manufacturers or distributors. Breather strainers must be watched carefully, especially in dusty atmospheres, since they may become loaded and plugged preventing free entrance and exit of air.

A strainer in the inlet pipe leading to the pump is

highly recommended. This is usually in the form of a cylindrical wire mesh screen, fine enough to prevent solid contaminants from reaching the pump and valves, but capable of passing the proper volume of oil necessary for proper pump operation. Usually, 60-mesh screen will be satisfactory and the net area should be 3 to 4 times that of the inlet pipe. Some machines are now equipped with inlet filters of the mechanical type having spaces as fine as .001 inch.

It seems ridiculous, in view of the apparent common sense maintenance behind the use of such filters, to even caution against their removal. Still, I have seen many instances where filters and strainers were taken out because they became clogged too quickly and interferred with production. Such situations are usually discovered when the user is frantically trying to rebuild his machine after prolonged operation with hydraulic oil contaminated with a variety of abrasive materials. Moral—If the strainers clog too quickly, either get larger ones or set your cleaning schedule for more frequent attention.

By-Pass Filters

As we have seen, actual mechanical damage to the pump and other parts can be forestalled through the use of breather and suction pipe strainers. One thing further by way of maintenance of oil cleanliness remains, the installation of a by-pass filter for removing tiny particles such as oil sludge, lint, soot, fine dust, metallic particles too fine to be caught by the intake strainers and so on. Some filters of the Fullers Earth Variety are so constructed that they are said to remove water, acid and gummy particles.

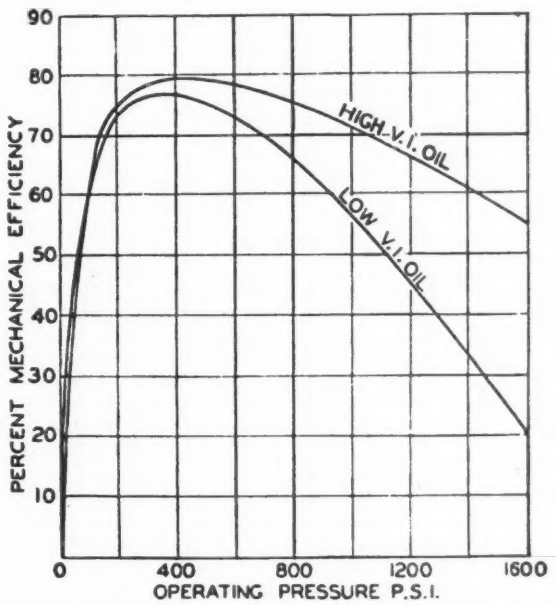
The contaminants of the above class are removed not only because of the damage they might do mechanically, but because some of them are destructive chemically. Altogether, they act to change the original properties of the oil until it is no longer fit for service. In other words, if systems were hermetically sealed, the oil would last indefinitely, as in the case of some of the well-known household refrigerator units which have been known to function for twenty years or more with the original charge of oil.

The matter of choice of filter should be discussed with the oil supplier, as well as the filter manufacturer, to see that the one is compatible with the other. For example, certain additives in oil are removed by particularly drastic filters.

A by-pass type filter is desirable since it does not interfere with machine operation and permits oil to be delivered to the pump at all times. It has been agreed that by-pass filters must be of sufficient capacity to filter the equivalent of all hydraulic fluid in the system within a period of eight (8) hours.*

Heat Exchange Units

The next important item following oil cleanliness is oil temperature. When hydraulic units are designed and tested, their performance is rated on the basis of oil viscosity within certain fluid limits. Designers must be practical about equipment and they, therefore, anticipate ambient temperatures normally encountered indoors in the average modern plant. There are times, however, when such conditions are not normal or average and ambient temperatures are either below or above these limits. Under such conditions, the oil in the system becomes too sluggish for proper pumpability or too thin to maintain pressure. Aside from effect on operation,



Graph showing efficiency vs. pressure—The above chart illustrates the effect of low VI oil on mechanical efficiency when operating pressures are increased. When oils thin out too rapidly loss in efficiency can result.

abnormal temperatures cause oil breakdown through formation of water-sludge from low temperature condensation, or thermal oxidation from elevated temperatures. The ideal operating oil temperature is about 125 F. with limits from 65 F. to 150 F. Opinions vary as evidenced by J.I.C. coverage of this point:

> "Under normal conditions of continuous operation, pump inlet temperature of the fluid shall not exceed 130 F."
>
> "In no case shall a sensitive temperature measuring device placed anywhere in the circuit indicate a local temperature above 250 F. (Petroleum fluids only. Other fluids require individual handling.)"

In selecting heat exchangers, several points should be considered:

(a) It must be accessible for servicing.
(b) It should be automatically controlled to provide fairly constant oil sump temperature.
(c) Exposed surfaces should be entirely compatible with hydraulic oil.

Despite the care exercised in the selection and maintenance of the hydraulic oil, it is nevertheless a fact that the time will come when the system should be drained, cleaned and fresh oil installed.

Service Period

Many attempts have been made to devise a yardstick by which useful service life of hydraulic oil may be

* Joint Industry Conference (JIC), Hydraulic Standards for Industrial Equipment, Detroit, Michigan.

measured. At the risk of becoming involved in strenuous argument, we are listing a set of limiting values of various physical laboratory tests on used oil samples which may be found useful.

Viscosity—allowable increase.....20%
Sludge (precipitation number) 2.0 Max.
Neutralization Number .....1.0 Max.

As a further guide, we use a test for determining the Resin or Gum Content of the used sample. This test indicates the amount of dissolved resin held in the oil and gives our laboratory a clue as to how near the oil is to permitting gumming or sticking of pumps, valves, pressure switches, etc.

For example, field test results over a period of 15 years have given us sufficient correlation with actual service results that we have been enabled to set limits on gum content. Using this test, we have found that a straight untreated petroleum oil having a gum content of .40 should be drained from the system and fresh oil installed. We have further found that, at this point of concentration, further gum formation would result in precipitation and resultant sticking of hydraulic parts. With an oil having additional solvent ability imparted by certain chemical treatment, this gum content can reach 1.0, or three times that of a straight mineral oil, before draining and replacement is necessary. Here we have one of the measuring tools so useful in determining not only the useful life of an oil, but the additional service life which might be anticipated through use of certain additive type oils.

Flushing and Cleaning Hydraulic Systems

In the past, many methods have been tried to maintain hydraulic systems in a reasonably clean condition. Such is particularly true when draining an oil prior to replenishment. Often such solvents as acetone, kerosene and various other petroleum solvents have been employed to remove sediment and oxidized oil from the system following the draining of the hydraulic oil.

Aside from the hazards connected with the use of certain inflammable solvents, such practices sometimes affect the metallic parts and packings adversely even though they remove the objectionable deposits. It is, therefore, much preferred to use a solvent which is compatible with all component parts of a system and, at the same time, affords lubrication protection to the pump. Such solvents are available for use either by themselves or in conjunction with the hydraulic oil.

In the former case, the oil should be drained and the system filled with the solvent flushing oil. The equipment is run under no load for periods ranging up to four hours. The solvent is then drained, the reservoir wiped dry and fresh hydraulic oil installed. Care should be taken to use lintless cloths such as cheesecloth or any hard fibered material.

The alternate method is to use a concentrated solvent which can be added to the hydraulic oil in the system in small percentages and the equipment run under normal conditions for a limited period of time. During this time, the added solvent dissolves the gummy and resinous deposits and, at the prescribed period, the unit is drained. This latter method has come into prominence during the past several years because of its time saving features as well as ease of use.

Reconditioning of Oil

Controversy has existed for many years regarding the pros and cons of the wisdom of attempting to reclaim petroleum oils for further service. Advocates of either side have certain arguments in their favor.

In our opinion, provided the right type of equipment is used, reclamation of oil resolves itself to a problem of economics. If the cost involved in the reclamation of used hydraulic oil is not considerably less than the cost of new oil, then the oil should be discarded and fresh oil supplied. If, on the other hand, atmospheric conditions surrounding the equipment result in premature contamination of large amounts of oil, then it would appear that frequent filtration or reclamation would be more economical than investment in new oil.

Several types of oil filters and reclaiming units are available, each of which has its particular advantages and disadvantages. If the hydraulic oil is used in large volumes, but contained in many small machine tools, then a unit of a portable nature should be used. Such a unit can be transferred from machine to machine and the oil reclaimed while the machine is being used.

If a large volume of oil is used in comparatively few units, then it may be less costly to use batch filtration wherein a portion of the oil is removed from the system and permitted to go through a reclaiming unit situated at a point some distance from the machine. Each type is available and care should be exercised to investigate the merits of each before a choice is made. Where Fullers Earth type filters are used, consultation should be had with the supplier of the oil to make certain that the additives in use in the hydraulic oil are such that they will be unaffected by such a filter. In cases where rust inhibitors are present, experience has shown that the new oil should be used for a minimum of 50 hours prior to filtration. This permits the anti-rust agent to plate out on the machine surfaces.

Summary

Summarizing, the characteristics to look for in hydraulic oils are these:

Of prime or absolute importance:

1. *Viscosity*
   Must be of correct fluid character to satisfy the requirements of the hydraulic mechanism under consideration.
2. *Lubricity*
   Must have sufficient lubricating value to amply protect the pump and other moving parts in the system.
3. *Stability*
   Must be highly stable in nature so that it can resist the destructive influences of heat, moisture, oxygen (air), metals, agitation, contamination, etc.

Of importance, albeit secondary importance:

1. Rust Protection.
2. Gum Solvency.
3. Foam Resistance.

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PUMP MANUFACTURERS' RECOMMENDATIONS FOR HYDRAULIC OILS*

GEAR-TYPE PUMPS

Manufacturer	*Operating Temp.*	*Viscosity at 100 F.*
Brown & Sharpe Mfg Co.		
Spur, spiral bevel, herringbone gear pumps...	None Specified	150-300 S.U.S.
Gerotor May Corp.		
Gerotor external-internal gear pumps.....	120-140 F.	250-300 S.U.S.
Hydraulic Press Mfg. Co.		
Hydro-Power gear pumps	——	950 S.U.S.
Northern Pump Co.		
Series 4000 pumps:		
Small	——	300 S.U.S.
Large	——	500 S.U.S.
Geo. D. Roper Corp.		
Series F and H rotary gear pumps.....	180 F. Max.	200-300 S.U.S.
Sundstrand Machine Tool Co.		
Type WX Rota-Roll Pump	120 F. Preferred	155 S.U.S.

AXIAL-PISTON PUMPS

Manufacturer	*Operating Temp.*	*Viscosity at 100 F.*
Denison Engineering Co.		
High-pressure, high-volume, constant-displacement Type 3500 series	Preferred: 110-130 F. Maximum: 150 F.	250-300 S.U.S.
LaPointe Machine Co.		
Variable and reversible discharge pumps	Preferred: 130 F. Maximum: 150 F.	200-210 S.U.S.
Northern Pump Co.		
Axial parallel-piston, Series 700	Maximum: 160 F.	450-650 S.U.S.
Vickers, Inc.		
Variable-delivery, piston-type fluid motor..	All Industrial Machinery	150-315 S.U.S.
Waterbury Tool Co.		
Variable-speed transmission and variable-stroke pump	Preferred: 120 F. Maximum: 150 F.	320 S.U.S.

VANE-TYPE PUMPS

Manufacturer	*Operating Temp.*	*Viscosity at 100 F.*
Racine Tool & Machine Co.		
Rotary-vane type, variable displacement...	Above 60 F.	200 S.U.S.
	Below 60 F.	75 S.U.S.
	Maximum operating temp.: 160 F.	

Vane-Type Pumps—(Continued)

(Industrial Machinery Installations; Ambient Temperature 50 F. to 90 F.)

Manufacturer	*Type of Installation*	*Viscosity at 100 F.*
Vickers, Inc.		
Vane type pumps.....	Machine tools operating at pressures up to 1000 psi.	150-225 S.U.S.
	Presses and other heavy machinery.	275-315 S.U.S.
Piston type pumps.....	All industrial machinery.	275-315 S.U.S.
Piston type and gear type fluid motors.....	All industrial machinery.	150-315 S.U.S.

RADIAL-PISTON PUMPS

Manufacturer	*Operating Temp.*	*Viscosity at 100 F.*
American Engineering Co.		
Hele-Shaw pump	Pressures below 1500 lb./sq. in. Below 100 F.	525 S.U.S.
	Pressures above 1000 lb./sq. in. Maximum: 100 F.	860 S.U.S.
	Pressures above 1500 lb./sq. in. Minimum: 100 F.	1250 S.U.S.
	Note: Minimum viscosity: 600 S.U.S. at operating pressure and temperature preferred.	
Hydraulic Press Mfg. Co.		
Hydro-Power radial pump	Preferred: 90-100 F. Maximum: 125 F.	850-1000 S.U.S.
Northern Pump Co.		
Series 5000	Maximum: 155 F.	650 S.U.S.
		300-350 S.U.S. min. at oper. temp.
Oilgear Co.		
Variable-displacement pumps and motors:	Max. preferred operating tem.: 140 F.	
Type F-to 10 hp.....	55 to 170 F.	550 S.U.S.
	40 to 70 F.	300 S.U.S.
Type C or D-100 or 150 hp.	55 to 170 F.	550 S.U.S.
	40 to 140 F.	300 S.U.S.
Type C or D-up to 60 hp.	40 to 160 F.	300 S.U.S.
	25 to 135 F.	150 S.U.S.
Superdraulic Corp.		
Constant and variable delivery pumps	Oil inlet temp.: Max.: 120 F. Optimum: 90-100 F.	150 S.U.S.

* Recommendations given above may vary somewhat from time to time depending upon manufacturers' experiences with pump in field.

The above recommendations are based upon information obtained by the author and represent average conditions. They are intended only as a general guide to the reader inasmuch as certain engineering changes in pumps or machine tools take place from time to time. For specific information consult the machine manufacturer or the oil supplier.

4. High Viscosity Index.
5. Pour Point.
6. Demulsibility.

The sole purpose of this article on hydraulic practices has been to depart, as far as possible, from the technical aspects of hydraulic fluids and, instead, supply facts which will be useful to those of you who have responsibility for hydraulic equipment.

We have found that the time to consider the *properties* of hydraulic oils is before they are purchased. This requires complete exchange of information between the user and the oil supplier.

Next, the *maintenance* of the purchased oil during service should be given the closest attention since the desirable properties of the new oil will be to no avail if contamination is permitted to continue.

Last, the *removal* and/or *reconditioning* of the oil should be given careful thought to permit an intelligent approach to the problem.

Attention to these functions will pay off in continuous, uninterrupted and efficient operation of your hydraulic machinery.

THE NATURE AND USE OF PETROLEUM BASE RUST PREVENTIVES*

by H. B. Carpenter
Staff Engineer
Esso Standard Oil Company
New York, N. Y.

Mr. Carpenter graduated from Cornell University as a Mechanical Engineer in 1915. After several years in chemical engineering he joined the Esso Standard Oil Company in 1933, where his work has been primarily in the field of product development.
Mr. Carpenter has had published several papers on rust preventives.

ABSTRACT

Products in this category have achieved considerable prominence during the past decade. They are used principally for the protection of finished iron and steel surfaces where the use of paint or a metallic coating is unsuitable. In addition to their rust preventive properties they are characterized by ease of application, ease of removal and their lubricating nature.
Straight petroleum oils or slushing compounds are not reliable rust preventives, but this limitation has been overcome by the use of inhibitors.
The four principal types of petroleum base rust preventives are described; namely, plastic, fluid, thin-film, and solvent. Various typical uses are discussed such as, machinery during shipment and storage, spare parts, anti-friction bearings, hydraulic devices and systems, gear cases, turbines, power transmission devices, instruments, farm machinery, strip and sheet metal, parts in process, etc. Application and removal are also covered.

The past 15 years have witnessed a considerable change in industry's attitude toward rust. Formerly, rust was accepted as a necessary evil, mainly because the available rust preventive compounds were none too reliable. The so-called "slushing compounds" had been in general use, but the protection they provided was not dependable, since uninhibited oil, petrolatum, or grease cannot be relied upon to prevent rust.

Then came the era of inhibitors, and the performance of petroleum products for many purposes was improved by the use of additives of various kinds. Success in one line turned attention toward others, and soon several laboratories were studying the possibility of insuring the protective value of petroleum products by the addition of rust inhibitors. This resulted in the development of petroleum base rust preventives as we know them today.

World War II gave great impetus to this young industry. For the first time many manufacturers were faced with the necessity of protecting metallic products and equipment against the effects of wide extremes of temperature and humidity, as well as against the corrosive action of salt air and sea water. Old methods of packaging were inadequate without an actual rust preventive film on the surface of the metal itself. In addition, increased precision, involving better finishes and lower tolerances, necessitated protection for parts in process. Greater decentralization of manufacture required that assembled units be prevented from rusting during shipment and storage prior to assembly. Contractors for machinery and equipment for the military services became convinced of the value of these newly developed products and have continued their use, so that today the use of petroleum base rust preventives is quite general.

The principal function of a rust preventive compound is to act as a moisture barrier. Some rust preventives also afford protection against the action of chemically corrosive gases, but this is usually a physical and not a chemical action.

At this point it might be well to mention that petroleum base rust preventives are not rust *removers*. Furthermore, they are effective only when applied to surfaces that are thoroughly clean and dry. The best rust preventives are ineffective when applied to a dirty or a moist surface. Rust itself is spongy and, if not removed, is likely to retain moisture, thereby promoting corrosion under the film. There is one exception to the rule about wet surfaces: a limited number of petroleum base rust preventives of the solvent type contain a water displacing additive and are designed for direct application to wet surfaces. We shall refer to this again later on.

In this discussion we are speaking particularly of the protection of finished surfaces. Corrosion of these surfaces represents a far greater monetary loss than the rusting of unfinished surfaces. The latter are effectively protected by a coating of paint or of a resistant

* Paper presented at 6th Annual Meeting, ASLE, Philadelphia, Pa., April 18, 1951.

metal such as tin, lead or zinc. However, such coatings are not suitable for finished surfaces, particularly those subject to sliding contact, as removal is difficult without damage to the surface. On the other hand, most petroleum base rust preventives are not only good lubricants in themselves but also compatible with conventional oils and greases. Removal is often unnecessary, but when desirable they come off easily by the use of mineral spirits or unleaded gasoline. The use of kerosene, however, should be avoided because of its tendency to promote corrosion.

Petroleum base rust preventives are characterized by ease of application, films which do not dry hard, ease of removal, and ability to lubricate. Generally speaking, they fall into the following four principal classifications, although our comments should be considered as being of a general nature, as doubtless among many manufacturers there are exceptions.

1. *Plastic types.* Products in this category are grease-like materials but, as very few contain soap, they are described by the word "plastic"—used in its true sense of moldable. The heaviest grade usually consists of petrolatum plus rust inhibitors. Other softer grades with somewhat lower melting points are obtained by the addition of varying percentages of an oil of fairly high viscosity. Ease of application, ease of removal, and the coverage per gallon increase as the consistency softens. However, the expected protection decreases.

These plastic compounds are characterized by moderate resistance to abrasion, a fair amount of self-healing power if the film is ruptured, and the ability to expand and contract with the metal. They also resist displacement from the pressure which often results from contact with the interior surfaces of shipping containers. Under conditions involving direct exposure to the elements, the heaviest grade affords the best protection of any of the petroleum base rust preventives. The outer surface will harden slowly, but the film underneath retains its softness and self-healing property. Plastic-type products should be used wherever practicable for protection during shipment and subsequent storage involving direct or semi-direct exposure to the weather.

Plastic-type rust preventives are used for the protection of the exterior finished surfaces of assembled machinery as well as for spare parts. The softer grades, such as those having an unworked penetration of at least 275, are particularly suitable for anti-friction bearings prior to the customary wrapping in glassine paper.

2. *Fluid types.* These consist of petroleum oils of various viscosities to which rust inhibitors have been added. As a general rule they are used where the plastic type is unsuitable or difficult to apply. This involves applications such as hydraulic systems, oil-lubricated bearings, gear cases, turbines, power transmission chains, delicate instruments, cutter bars, and strip and sheet steel. They are also used for the inspection testing of hydraulic system pumps, valves, actuating devices, etc. The rust preventive is drained at the conclusion of the test, but the interior surfaces remain coated with an effective rust-preventing film.

Modified fluid rust preventives are used for the protection of the interior surfaces of internal combustion engines. These products include a neutralizer for the acidic products of combustion and often other additives that enable them to serve as detergent motor oils, should this become necessary. In the aircraft field, the Government-approved rust preventives also serve as aviation engine oils when the finished planes are flown away from the plant of the manufacturer.

Fluid-type products have a tendency to drain or to be removed by wick action. Although this may result in less permanent protection than is afforded by the plastic type, the service records of these products are excellent.

A serious misconception exists regarding one type of rust inhibited oil. Many prime grade turbine oils contain what is called a rust inhibitor. Although this term is correctly used, the inhibitor is actually designed to protect *only* against rust caused by water that has contaminated the turbine oil. So far as we know, such inhibitors furnish no protection against humid or corrosive atmospheres. For example, these inhibited turbine oils prevent rust in those parts of the lubricating system which are in contact with the mixture of oil and water. However, the thin film of the oil adhering to the walls of the reservoir above the oil level and to the underside of the cover will not prevent corrosion.

3. *Thin film types.* This is somewhat of a misnomer in that certain other petroleum base rust preventives also leave a thin film. However, the term "thin film" as used in the field of rust prevention usually refers to a particular type of product containing roughly 50% of a petroleum solvent which evaporates leaving a reasonably hard, thin, non-transparent film. This type is used instead of the plastic type for certain classes of service. As a rule, it is easier to apply. It should be borne in mind, however, that many of these so-called "thin film" products are not lubricants, nor are they compatible with conventional lubricants. As a result, removal from surfaces subject to sliding contact must be done carefully and thoroughly.

4. *Solvent types.* In general, these products consist of solutions of rust inhibitors in mineral spirits which upon evaporation leave a thin, transparent rust preventive film. They differ from the thin film type described above in that the film does not dry hard but remains somewhat flexible and tacky over long periods. The lighter of these solvent products are not suitable for use outdoors, but give excellent indoor protection, particularly on materials or parts in process, without interfering with visual inspection or the reading of identifying marks. Some of the lighter products are modified by the addition of water displacing and fingerprint neutralizing properties. When applied to a wet surface, the water is immediately and completely displaced, fingerprint residues are neutralized, and the surface is left coated with an effective rust preventive film. This combination of properties is particularly useful in such cases as that of machined parts coming off a tool which uses a soluble oil emulsion as a coolant. Alongside of his machine the operator has a small pan of the rust preventive into which he dips the parts, thereby completely removing the emulsion and neutralizing his fingerprints. The part then goes into the tote box fully protected. In other cases parts that have been cleaned with acid or alkali are rinsed and then passed through the rust preventive. The rinsing, however, must be thorough in order to prevent the possibility of an adverse reaction between the acid or alkali and the rust preventive.

The film of the lighter solvent-type products is so thin—usually not over 5/10,000 of an inch thick—that in most cases removal is unnecessary. In other cases, these products serve as excellent primers for the heavier petroleum base coatings. Heavier solvent-type products containing a higher percentage of a non-volatile base are also easily applied and furnish excellent outdoor protection for limited periods.

The development of effective rust preventives has necessitated the development of laboratory methods for the evaluation of their performance. Considerable prog-

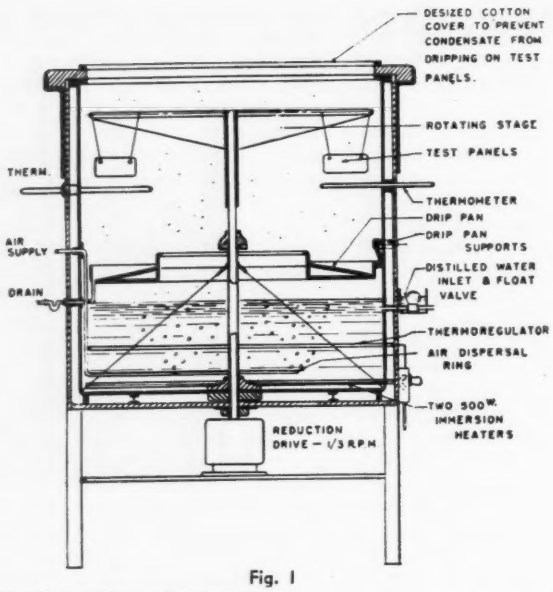

Fig. 1
Humidity Cabinet—Rotating Stage

ress has been made but further improvement is desirable. Also, a reliable means of predicting service life from laboratory results is needed. The most commonly used performance test (illustrated in Fig. 1), is known as the humidity cabinet where mild steel panels, usually 2"x4"x1/16" thick, after being sandblasted or polished, are coated with the material under test and exposed to a temperature of 100 F. or 120 F. and a relative humidity closely approaching 100%. The rust preventives are rated by the number of hours elapsing before rusting occurs. This test indicates the relative protection to be expected from exposure to atmospheric humidity.

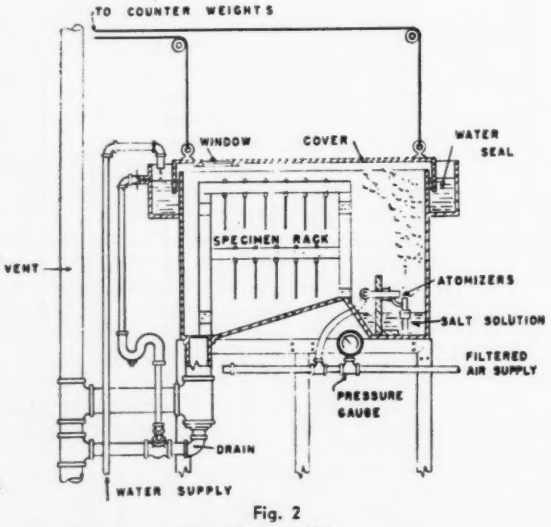

Fig. 2
A.S.T.M. Fog Chamber for Salt Spray Test

In the salt spray test (see Fig. 2), similar panels are exposed to an atmosphere of atomized sodium chloride solution. The results give a fair idea of the relative protection to be expected from exposure to salt-laden atmospheres such as those encountered in ocean shipment. Another test involving immersion in synthetic sea water gives similar indication.

Exposure in a weatherometer indicates relative resistance to removal by the action of the elements, as well as resistance to the corrosive action of these elements.

The results from these laboratory tests are not as reproducible as might be desired, but they are very informative providing it is borne in mind that they indicate simply an order of magnitude. For example, a product that furnished protection for 225 hours in a humidity cabinet should not be classed as superior to one that ran 200 hours. One that protected for 200 hours should be considered better than one that gave 100 hours, but there is no reason to feel that it would give twice the protective life in actual service.

Now we come to the matter of application. As previously mentioned, rust preventives should be applied only to surfaces that are thoroughly clean and dry, with the single exception of the application to wet surfaces of a solvent-type product with water displacing properties.

There is no universal method of cleaning that will properly condition all surfaces for the application of protective coatings. Where rusting has already occurred, the use of steel wool, wire brushing, or even sand or shot-blasting is effective. A hot alkali bath followed by a thorough rinse is also suitable. Chlorinated solvents have given a good account of themselves, although care must be taken to make certain that there is no chlorine liberated in a way that permits a union with water to form corrosive hydrochloric acid. Where the contamination consists of dirt held in place by oil or grease, the use of petroleum solvents is probably the most efficient method. Mineral spirits, also called Stoddard solvent or dry cleaners' fluid, is the most generally used petroleum product. It has the advantage of a higher evaporation rate than kerosene, without increasing the fire hazard, according to the classification of the Underwriters' Laboratories, Inc. Here again the use of kerosene should be avoided. Care should be taken to keep a petroleum solvent from contact with rubber or other materials that would be affected. The use of a clean solvent is essential and it must be replenished whenever it becomes sufficiently contaminated to prevent fulfillment of its purpose.

Fingerprints, as most of us realize, actively promote corrosion. The best protection is obtained by personnel wearing canvas or synthetic rubber gloves. However, this is not always practical and, although the use of bare hands does not necessarily deposit fingerprints, the chances are sufficiently great to warrant preventive measures. So far as we know, these deposits are not removed by mineral spirits or other commercially used cleaning agents. Conventional rust preventives are also ineffective, but solvent-type products to which fingerprint neutralizing agents have been added have proved very effective over a considerable period of time. These special products have found wide acceptance in industry.

The removal of moisture or a soluble oil emulsion from a surface before the application of a rust preventive is often not as simple as it might appear. The use of compressed air or cloths is apt to cause contamination. The former may not be dry, clean, or oil-free, and cloths are hard to keep clean and dry and may leave lint on the dried surface. Here again, the advantages of a solvent-type rust preventive with water displacing qualities are apparent.

Although the supplier of a rust preventive compound is the one best qualified to specify the proper procedure for application, the following general comments may be helpful. Application should be made as promptly as possible after cleaning, and in such a manner as to give a uniform and continuous coating to the surfaces

to be protected. Dipping is preferred wherever possible, since it insures complete coverage, although spraying is also effective. Application may also be made by brush, swab, or roller.

Whenever possible, liquid-type rust preventives should be drained, filtered, and reused, with the exception of the internal combustion engine type, in which service the acid neutralizer is consumed. Reuse must, therefore, be confined to application by brush or swab. Too rapid chilling of the compound prevents a good bond. Generally speaking, the plastic-type compounds cannot be sprayed, although equipment is available which will apply the medium and softer grades by this method. As an alternate to heating, plastic-type products may be cut back with mineral spirits, which evaporates after application. Heating is preferred, however, since somewhat better protection results and additional time is not required for the evaporation of the solvent.

It is often unnecessary to disassemble such machinery as turbines, gear cases, cylinders, etc., for the application of a rust preventive oil to the interior surfaces. Fogging by high pressure spray through openings can be quite effective, although this method must be used with discretion if complete coverage is to be obtained.

Whenever possible, liquid-type rust preventives should be drained, filtered and reused, with the exception of the internal combustion engine type, in which service the acid neutralizer is consumed. Reuse must, therefore, be confined to applications which do not require this characteristic. The manufacturer of the rust preventive compound is the one best qualified to recommend suitable types of filter media. For many products, however, the rust inhibitors are in true solution and will pass unchanged through most of the chemically inert filtering media. When liquid rust preventives are drained, the film remaining on the coated surfaces will provide full protection, although it is often wise to attach a prominent tag calling attention to the need of refilling with the normal lubricant before operation.

The thin film or solvent-type products may be applied by dip, spray, or brush. Care must be taken not to apply petroleum base rust preventives to non-metallic parts such as those fabricated of rubber, cork, paper, leather, fabric, or plastics. Where contact cannot be avoided by shielding or other means, the heaviest of the plastic-type compounds should be used. This very viscous type will have the least and probably an unappreciable effect since it contains but little oil.

It is important that certain precautions be taken when application is made by spray. All petroleum products, when atomized, represent a health hazard if taken into the lungs in any appreciable quantity. It is therefore recommended that adequate local ventilation be provided when a petroleum base product is applied by spray. Proper precautions, as established by the National Board of Fire Underwriters, must also be taken in connection with any possible fire hazard.

When an internal combustion engine is to be protected, the following procedure is recommended. The crankcase is drained, flushed, and refilled with the rust preventive oil, using the minimum quantity necessary for safe operation of the engine. After this, the engine is operated for a short period at idling speed and no load. The rust preventive is then injected into the cylinders above the pistons by pouring it slowly into the carburetor air intake in the case of spark ignition engines, or by using it as fuel during the last few minutes in the case of diesels. After the engine stops and has cooled, the spark plugs or fuel injectors should be removed and the preservative fogged into each cylinder with the piston down in each case if possible. Before replacing the plugs or injectors, the engine should be turned over a few revolutions to obtain complete distribution.

As would be expected, petroleum base rust preventive compounds may be removed with petroleum solvents. Mineral spirits is preferred, although white (unleaded) gasoline is also suitable. Rags or waste soaked in hot water may be used, but this method is apt to be more laborious. Many of the rust preventive compounds are lubricants and need not be removed from bearings, gears, etc., although all sumps, reservoirs, and crankcases should be drained and refilled with the lubricant recommended for regular service.

Getting down to specific applications, there seem to be three categories in which the use of rust preventive compounds can very profitably be considered.

The first is machinery or equipment for shipment or kept in standby storage without disassembly. Any attempt to prescribe in detail for this classification would be impractical, but we believe the proper type or types of products and methods of application can be determined from the general descriptions previously given in this paper.

The second group includes tools and spare parts in storage, such as rolls, saws, mandrels, gears, armatures, heavy machine parts, housing screws, steel dies, etc. Here again the nature of the part to be protected will indicate the proper type of rust preventive.

The third category covers finished products. For sheets, strip steel, bar stock, etc., protected from the weather, a fluid or solvent-type product should be used. Preservatives of this class have also given very satisfactory service on continuous strip mills and on steel wire between drawing and stranding in rope manufacture. For products shipped exposed to the elements, hard-drying rust preventive compounds should be used, although these are not of petroleum base.

As a rule the selection of the proper type and consistency or viscosity grade represents a compromise between ease of application, the severity of storage conditions, and ease of removal. Naturally cost is also a factor, but the difference in cost between various grades is small enough to place this factor in a position of secondary importance. The cost of improper protection is too great for it to be otherwise. Ease of application or removal, while a definite consideration, should also not be permitted to have too great an influence, for generally those products most difficult to apply or remove furnish the best protection.

In conclusion, stress should be laid upon the definite economic advantage to be derived from the use of good rust preventive compounds. Rust removal is expensive. When remachining is required, a change in dimension results which often requires even more expensive machine work to the companion member. Rusty spare parts have caused the loss of valuable machine hours and even held up plant operation. Good rust preventive compounds are not cheap compared with the cost of other petroleum products of similar consistencies, but a careful analysis of the potential savings to be obtained from their use is very apt to surprise those who have not looked into the matter previously.

WIRE ROPE LUBRICANTS AND LUBRICATION*

by J. P. Critchlow
Chief Fuels & Lubricants Engineer
Rolling Mill Section

and

R. W. Flynn
Senior Staff Engineer
New York Division
Gulf Oil Corporation
Pittsburgh, Pa.

Mr. Critchlow obtained his B.S. degree in Mechanical Engineering from Carnegie Institute of Technology where he was also employed for four years as part-time instructor in the school of Mechanical Engineering.
He spent thirteen years in various engineering and production capacities with the Mesta Machine Company. In 1947, Mr. Critchlow joined Gulf Oil Corporation as a Lubrication Engineer. In 1949 he was appointed Chief, Fuels and Lubricants Engineer—Rolling Mill Section, which position he now holds.
He is a member of AISE and ASME.

Mr. Flynn graduated from Northeastern University, College of Engineering, in 1926 with a B.S. degree in Mechanical Engineering. He did some graduate work at Northwestern University in Chicago, while employed by the Worthington Pump and Machinery Corp., in the capacity of sales and service engineering of power plant machinery.
He has been engaged in lubrication engineering for over seventeen years with the Gulf Oil Corp., where he has held various lubrication engineering positions, culminating in that of Sr. Staff Engineer, New York Division, which position he now holds.
Mr. Flynn is a member of ASLE, ASME and SAE.

ABSTRACT

Wire rope lubrication is highly specialized, and its importance from a safety as well as maintenance viewpoint cannot be overemphasized. Various types of wire rope lubricants and their merits are discussed. Performance data obtained in the field and on special laboratory equipment are presented. Materials for treating and lubricating fibre centers are included.

At a glance, wire rope appears to be a simple piece of equipment composed of numerous small steel wires twisted around a core and used as a compromise between solid steel wire and ordinary hemp rope for the obvious purpose of securing the strength of steel and the flexibility of hemp.

The simplicity of wire rope stops, however, with its appearance. Actually a wire rope is a complex machine composed of many moving parts requiring precise engineering in its design and skill and care in its manufacture. For instance, a 6x41 filler wire, IRWC rope is made up of 295 wires or machine elements of various sizes, each designed and manufactured with precision and exactness.

This is just one of the many types of wire rope for, even though all wire rope is used as a flexible means of transmitting power or sustaining loads, the different service conditions in its many fields of use require that it be made in a variety of constructions. By varying the analysis of the steel, the type of core, the number of strands, the number of wires per strand, the strand and rope lay, etc., it is possible to produce an almost infinite number of combinations.

It is not the purpose of this paper to discuss the design and construction of wire rope and their applications so only those phases that will affect the selection of a material to lubricate and protect a wire rope in storage and in service will be covered.

Having established a wire rope as a precision machine, it is only logical that it be treated as such and not as an ordinary, relatively unimportant and obscure piece of operating equipment. Like any machine, abuse, misuse, improper handling and maintenance procedures will shorten the life of the machine and just plain increase the cost of any operation.

When approaching the problem of lubricating any machine one should investigate its general construction and design, the materials used, the loads imposed on its various elements, and the conditions under which it must operate. In the case of a wire rope we find, as mentioned previously, many different constructions. In general a wire rope is made up of a number of steel wires wound helically around a center of usually another wire or fibre to form strands which in turn are

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wound helically around a core usually of fibre, another wire strand or wire rope to form the finished rope. The analysis of the steel in the wire can be varied depending on the strength or wear resistant characteristics desired, the size, number, and arrangement of the wires can be varied depending on the degree of resistance, wear or flexibility desired, and the type of core can be varied depending on the load carrying ability, flexibility, and heat resistance desired. In addition, of course, there are several arrangements of rope and strand lay which impart various strength, wear resistant, and flexibility characteristics to the finished rope.

Further analysis shows that the individual wires in a wire rope under either dynamic or static loading are subjected to a combination of stresses including tension, compression, torsion, shear, and fatigue which are extremely complex and practically incapable of analysis. Each wire bears on adjacent wires and theoretically these bearings are line or point contact. Actually, the bearing points or lines of the wires are deformed until there is a finite bearing area created which is sufficient to support the applied load. The bearing pressures between wires, however, are obviously extremely high as is the friction between the wires.

With very few exceptions, an effort is made to reduce friction in any machine or machine element for the obvious purpose of reducing wear and allowing for the relatively free movement of machine elements. Friction between the wires and strands of a wire rope can result in the unequal distribution of the applied loads and lead to stress concentrations that may, and frequently do, cause premature failure of the rope. It is therefore, imperative that every effort be made to reduce and equalize the friction in a wire rope.

The foregoing is a brief resume of the design and construction features of wire rope as they pertain to lubrication. The conditions under which a machine operates are also extremely important from the standpoint of lubricant selection and wire rope is by no means an exception. The wide variety of uses for wire rope makes this factor even more important. In the steel industry, which is probably the largest single user of wire rope, it is found on cranes that operate outdoors in all sorts of weather, around open hearth furnaces and soaking pits and various intermediate conditions. Wire rope will be found as an integral part of machines on ore bridges, blast furnaces, conveyors, loaders, car dumpers and various other devices throughout the steel industry where it is subjected to all sorts of conditions from the extremes of weather to extreme heat, dust, dirt, water, etc. The second largest user of wire rope is the petroleum industry where it is used mostly as a component of drilling machinery being subjected to the extremes of weather, various types of drilling fluids, corrosive atmospheres found in wells, etc. Wire rope is used extensively in the mining industry and the heavy construction field where again it is subjected to all types of weather and various degrees of atmospheric contamination. In fact, the use of wire rope has become so widespread that hardly an industry can be mentioned that does not require wire rope for some application.

In general, it is apparent from the foregoing that wire rope in service is subjected to the extremes of weather found the world over, extremely hot conditions such as found in certain phases of the steel industry, atmospheres that are overly corrosive such as found in oil and gas wells and severe abrasive conditions such as in the heavy construction field where ropes are dragged over rocks, sand, dirt, etc. All of these conditions can lead to early and severe corrosion in a wire rope and premature rope failure unless properly handled. It has been said many times that corrosion is the largest single cause of wire rope failure and from the foregoing it is apparent that all of the factors necessary to cause severe corrosion are usually present for most wire rope applications. It is also apparent that even slight corrosion can prevent the free movement of the wires and strands in a wire rope causing an unbalanced and unequal distribution of applied loads leading to fatigue failure.

Having analyzed wire rope—the machine—from the standpoint of design, construction, materials used, loads imposed, and conditions of operation, it is found that the ideal lubricant should reduce friction between wires and strands, thereby permitting their free movement, and prevent corrosion of the steel phase of the wire rope under the variety of operating conditions encountered. There is another very important function of a wire rope lubricant that has not been covered thus far and that is its function of protecting and preserving the fibre core when this type of core material is used. The core is the supporting member of the rope, and, as mentioned previously, two general classes of core materials are used—metallic and fibre. Metallic cores may be a wire strand or a wire rope and lubrication wise may be treated the same as the completed wire rope. A fibre type core imparts to a wire rope better flexibility but less compressive strength than a metallic core. This type of core presents lubrication and protection problems that are a little different from the steel phase of the rope.

A fibre core in order to perform its function as a support for a wire rope must maintain its compressive strength. In other words, in service, it should not be allowed to dry out or deteriorate to the point where the fibres break and become pulverized thus losing their strength and ability to support the wire rope. A dry fibre core can also be extremely abrasive and cause considerable wear on the wire strands imbedded in it or in contact with it. Further, a dry core tends to absorb moisture, which may promote corrosion of the internal steel wires. Still another point that is undesirable is the acid condition that may develop in some fibres due to the action of bacteria. Such a condition also can promote internal corrosion in a wire rope. It is quite apparent, therefore, that a fibre core requires special attention not only from the standpoint of protection and preservation but also with respect to internal corrosion. These factors are all the more important because it is practically impossible to inspect the condition of a core or adjacent wires in a wire rope in service. In summary, the ideal wire rope lubricant should perform a triple function, that of reducing and equalizing friction, preventing corrosion of the steel, and protecting and preserving the fibre core when one is used.

To design a lubricant that will satisfactorily fulfill these three functions requires that the relative importance of these functions be analyzed. The importance of the lubricating function of the lubricant in reducing friction and equalizing the load distribution in a wire rope has been demonstrated by a series of tests on a $\frac{7}{8}$", 6 x 19, right lay, Warrington Rope, the breaking strength of which was 45,600 lbs. Three samples of the same rope, representing full lubrication, core lubrication only, and no lubrication, were subjected to a pulsating tensile load varying between 10,000 and 20,000 lbs. as limits until failure occurred. The test specimens were especially laid-up for this work. The specimen representing full lubrication had a heavy bodied petroleum type wire rope lubricant applied to each strand on the stranding machine and again to the strands and core on the closing machine. The specimen representing core

lubrication only had the same heavy bodied petroleum type lubricant applied to the core only on the closing machine; no lubricant was applied to the individual wires on the stranding machine or the strands on the closing machine. The specimen representing no lubrication was laid up dry; no lubricant was applied at either the stranding or closing machine and the core contained only the cordage oil used by the cordage manufacturer in spinning the hemp fibres. The machine used was a tensile machine modified to produce a pulsating load between controllable upper and lower limits at the rate of approximately 400 pulsations per minute. The appearance of these ropes after failure is shown in Figure 1, and the number of pulsations in load to complete failure are given in Table 1 along with significant data on the amount of lubricant in the core of each rope before and after testing.

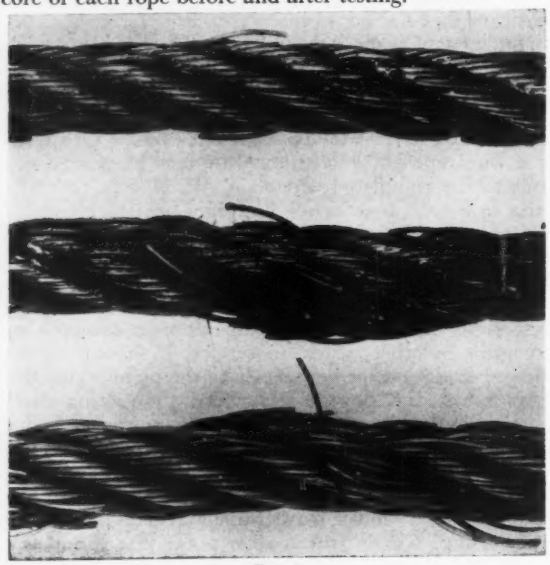


Fig. 1
Tensile Fatigue Failures in Wire Rope.
Top: Fully Lubricated; Center: Core Only Lubricated; Bottom: No Lubrication

TABLE 1

Condition of Rope	Number of Pulsations to Failure	Total Lubricant in Core % of gross core wt. Before Testing	After Testing
Fully lubricated	4,907,375	25.52	16.42
Core only lubricated..	1,782,425	25.28	15.37
No lubrication.....	564,400	7.57	....

Although some wires were broken in every strand of the rope without lubricant, the principal failure was confined to two strands, an indication of poor load distribution. The rope with only the core lubricated failed in a similar manner but some benefit was obtained from the lubricant that was squeezed from the core; more pulsations were endured before failure because the strands were more uniformly stressed. The fully lubricated rope, in which both the core and the strands were lubricated, failed to an almost equal degree in all six strands but only after it had endured nine times as many pulsations as the rope without lubricant and better than 2.5 times as many as the rope with only core lubrication.

These tests were of relatively short duration so that corrosion was not a factor. There was no evidence of either internal or external corrosion on the test specimens. It is, therefore, apparent that unless friction is equalized and reduced to a minimum by means of a suitable lubricant the service life of a wire rope can be appreciably shortened. This applies particularly to ropes that operate in more or less protected indoor areas where conditions are not as conducive to corrosion as outdoor installations.

In analyzing the importance of internal and external corrosion in the service life of a wire rope one is faced with a rather complex problem due to the wide variety of conditions under which a wire rope must operate and the length of service that is expected of some wire rope installations. As pointed out previously, corrosion not only reduces the strength of a wire or strand thereby reducing the load a rope will safely carry, but can increase the friction between wires and strands which causes an unequal distribution of the load and leads to premature fatigue or tension failure. High friction may also cause nicking of the wires which, too, creates an unbalanced condition and early failure. There is, therefore, very little doubt that corrosion is a major cause of wire rope failure, particularly for those ropes operating outdoors or in relatively unprotected areas.

In general, a two step procedure is required to reduce friction and corrosion to a minimum and to improve core protection and preservation. The first step is the application of the most suitable lubricant during the manufacture of wire rope and the second, the application of the proper lubricant to the rope in the field. Both steps are extremely important and have a decided effect on the service life of the rope.

From an application point of view, step one is the easier to handle because, obviously, conditions in a wire rope mill are far more favorable and uniform than in the field. Further, it is possible, during the laying up of a strand or the closing of strands into rope, to apply a lubricant so that each wire in the rope is thoroughly covered.

A suitable lubricant for application to wire rope at the wire rope mill should, therefore, have characteristics such as the following:

1. It should be capable of providing a tough lubricating film on the individual wires because of the high unit pressures existing between wires and strands.
2. It should provide a strongly adhesive film and be highly resistant to the washing action of water and other corrosive fluids so that good corrosion protection is provided for long periods of time.
3. It should protect and preserve a fibre core by reducing the wear between fibres and steel wires and by failure to support bacterial growth in the fibre; it should not harden or soften the fibres of the core.
4. It should not chip, peel, or crack at temperatures down to about — 15 F., thereby exposing the steel wires to the atmosphere and the possibility of corrosion.
5. Its melting point should be sufficiently high to prevent dripping in warm weather or in hot storage buildings.
6. When applied hot in its fluid state to the wires and strands at the rope mill, it should solidify rapidly providing a smooth, uniform film over the wires and strands.

There are available several especially compounded heavy bodied petroleum compounds that have the above characteristics. There are many methods used to apply lubricant to the wires at the stranding machine, differing with each other usually only in mechanical arrangement. The objective of all methods is to apply the wire rope lubricant to individual wires in its fluid state so that

good coverage is secured. In a typical application method the lubricant is heated in a reservoir to temperatures varying from approximately 200 F. to as high as 300 F., depending on the characteristics of the lubricant used. It is then pumped to a nozzle located above and slightly ahead of the closing die so that individual wires are coated as they are laid up at the stranding machine. The lubricant should solidify and set up, forming a smooth, uniform film over the wires before the strand reaches the winding reel. Additional lubricant may or may not be applied at the time the strands are closed around a cone into a finished rope. Ropes for marine service, some drilling line, and other ropes that are to be subjected to severe water or weathering conditions usually have additional lubricant applied at this point of manufacture.

Applying a suitable lubricant to a fibre core is a little more complex inasmuch as there are usually two materials involved. In making fibre rope for wire rope centers a light cordage oil is used as an aid in spinning the fibres into strands. The oil is usually a straight mineral oil having a viscosity of about 100 SSU at 100 F. About 4 to 8% of the gross weight of the finished core is cordage oil which has practically no value as a wire rope lubricant. Some cordage manufacturers lubricate the fibre core with the same or a similar material as used on the wire rope by immersing the core in a bath of wire rope lubricant in its fluid state for a period sufficient to insure thorough impregnation. About 14 to 16% of the gross weight of the finished core is then wire rope lubricant. Other cordage manufacturers may use materials that differ slightly from regular wire rope lubricants in their make-up. Whatever material is used should be designed to protect and preserve the fibre core, minimize or eliminate the action of bacteria, protect the steel strands imbedded in it from corrosion, and reduce the wear between fibre strands and steel strands.

In many instances the lubricant or additional lubricant is applied to the fibre core by the wire rope manufacturer. In one method used for impregnating the fibre core at the wire rope mill the core is passed through a bath of heated wire rope lubricant as it enters the closing machine. The same lubricant is used on the core here as is used on the wire rope.

It is obvious from the foregoing that the most important phase of wire rope lubrication is at the point of manufacture because it is only when individual wires are being laid up into strands and strands closed into finished wire ropes that thorough lubricant coverage of all of the components of a wire rope can be secured. Many wire ropes get no further lubrication. In some cases it is not necessary. For most wire rope applications, however, it is decidedly necessary but due to a lack of knowledge of the importance of re-lubrication or a lack of suitable re-lubricating facilities, many wire ropes in the field are neglected.

Wire ropes in the field need to be re-lubricated for the very simple reason that the lubricant applied at the wire rope mill does not last forever and contrary to some beliefs the fibre core is not an endless reservoir for supplying lubricant to the rope during its useful life. A fibre core in a wire rope in service will gradually dry out if its lubricant content is not replenished. A dry core will gradually disintegrate causing rope collapse. A dry core can be quite abrasive causing severe wear on the wires imbedded in it. A dry core also has a tendency to absorb moisture which will lead to rapid corrosion of the steel phase of the rope. Figure 2 shows a strand removed from a wire rope used for hoisting service. The worn and corroded phase of this strand was the part of

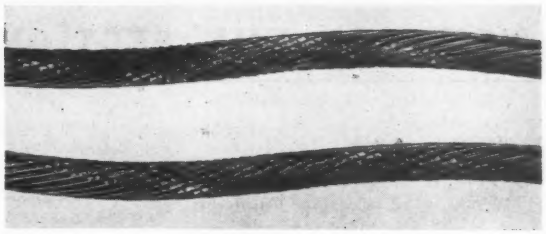


Fig. 2
Internal Corrosion on a Wire Strand

the strand that was imbedded in the fibre core. When the core was examined it was found to contain only 3.3% by weight of lubricant; for all practical purposes it was dry. Had a lubricant that would have penetrated to the core been used on this rope in service this condition may not have happened.

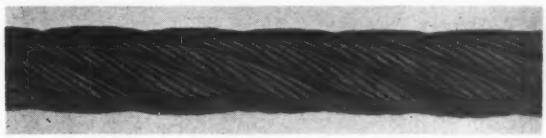


Fig. 3
External Corrosion on a Wire Rope

Figure 3 shows an example of external corrosion on a wire rope. This rope was also used for hoisting service. The section of this rope shown was removed from the drum end position, incidentally, which shows clearly that the drum end of the rope cannot be neglected.

It is beyond the scope of this paper to show the many varieties of relubrication methods that can be used on wire rope in the field due to the wide variety of wire rope applications. What should be remembered is that a wire rope in service does not need to be re-lubricated. For best results the wire rope should be cleaned before the lubricant is applied, if at all possible, so that all dirt, dust, and other contaminating materials are removed from the valleys between the strands and the space between the outer wires. The cleaning can be accomplished with wire brushes and/or kerosene, not with steam. It is realized that cleaning a wire rope in service is, many times, impractical but the recommendation is made because far better protection is secured on any metal surface if it is properly prepared to receive the lubricant.

In general, the best lubricant to use for re-lubrication of wire rope in the field is the same type of lubricant that was used when the rope was manufactured but due to the arrangement of most rope applications and in view of the heavy bodied nature of these lubricants it is practically impossible, in many cases, to apply them in the manner in which they should be applied, that is by heating them to a temperature that will make them sufficiently fluid to penetrate to the core. If facilities are available for heating the lubricant and the rope is arranged so that it can be passed through a bath of hot lubricant, effective re-lubrication can be secured. Lubricants, such as used on the rope when it is manufactured, and diluted with a suitable volatile solvent can be applied to the rope in field, without heating, either by dripping continually as the rope passes over a sheave, for instance, or by brushing. These types are also effective because they give good coverage, penetrate to the core and leave a good strong uniform film after the solvent has evaporated. Some users of wire rope, such as in the heavy construction field, apply an extreme

(*Continued on page* 195)

NEWS OF THE SECTIONS

ST. LOUIS

By G. M. Daily, Magazine Correspondent

"The Action of Cutting Fluids in Machining," by Dr. M. Eugene Merchant, Senior Research Physicist, Cincinnati Milling Machine Co.—May meeting.

What does cutting fluid do?

What are its functions?

How does it help?

What does it do in the machining process?

The answers to such questions have been the subject of research for many years.

If we understand the sources of heat and abrasion, we can better know the desirable characteristics of a cutting fluid in reducing such heat and abrasion, the enemies of cutting tools.

The combination of the machine and tool, the worked metal, and the cutting fluid produce one of three types of chips:

1. The segmental or discontinuous chip which is that chip which breaks into small pieces because the cutting process produces deformation which the worked metal cannot take.

2. The simple or continuous chip which is that ribbon type chip moving up the face of the tool. The metal deformation is considerably less.

3. The high friction chip which produces excess friction between the tool and the chip resulting in a built-up edge on the nose of the tool. This is a continuous chip, but is formed in an inefficient manner.

Common to all three types of chips are the deformation of metal and the escape of the chip up the face of the tool. Both of these processes produce heat. Abrasion results from tool, work and chip being pressed together at pressures sufficient to produce localized welding. The two undesirable factors, heat and abrasion, are cooperative, one with the other: abrasion produces heat and heat makes abrasion more possible.

The cutting fluid has the purpose of improving machine operation or more specifically, reducing heat and abrasion. It has been observed that the cutting fluid does have an effect in increasing the shear angle and thus reducing deformation and its resultant heat. At the same time the proper fluid reduced friction and its accompanying abrasion between chip and tool.

Experiments were made to determine what property of the cutting fluid produced the desired results and those experiments lead to the conclusion that the chemical composition of the fluid produced a reaction with the chip, prevented welding, reduced friction, reduced deformation and consequently, reduced heat at its origin.

LOS ANGELES

By E. E. Perso, Chairman

"Common Causes of Internal Combustion Engine Bearing Failures," by R. J. Tanner. Research Engineer, Union Oil Co. of Cal.—May meeting.

Mr. Tanner's talk was based upon the premise that the engine manufacturer had done his job well in providing bearings of adequate size, properly designed and composed of suitable materials to provide satisfactory bearing life under the loads and speeds for which the engine was designed.

Usually, bearing failures are due to some form of metal fatigue induced by the operating conditions. Bearing metals have certain tensile strengths and hardnesses. Overheating, whether general or local, contributes to the metal fatigue. Shock resistance of the bearing metal is another important property adversely affected by high temperature.

Mr. Tanner segregated bearing failures into three main classifications. The most frequent cause of failure is due to dirt in some form being carried into the bearing by the oil. The second most frequent cause of failure is improperly fitted bearings due to poor mechanical workmanship at the time of installation. This is rarely due to poor manufacture. The third most frequent type of failure is due to operating conditions.

A detailed description was given of various types of bearing failures and actual bearings which had failed under these conditions were shown and their characteristics were described to help in identification. In general, whenever bearing failures are encountered the failure is attributed to oil, but experience shows this is rarely, if ever, true.

Mr. Tanner emphasized in his talk, that dirt in the engine is the main cause of bearing failure.

DETROIT

By E. S. Kelly

The Detroit Section is sponsoring its "Annual Stag Outing" at the Hill Crest Golf and Country Club on Saturday, September 11, 1951. Features of the day include golf matches, soft-ball game, egg tossing contests and horse-shoe pitching, followed by the annual banquet with suitable entertainment and awarding of prizes. The recently organized Saginaw Valley section has been invited to participate. This event promises to be outstanding in the history of the Detroit Section.

Tickets may be obtained from L. B. Smith, D.S.R., 11200 Shoemaker, Detroit 31; John Clark, Packard Motor Car Co., 1580 E. Grand Blvd., Detroit 32 or E. S. Kelly, The Budd Co., 12141 Charlevoix Ave., Detroit 14.

NEW YORK

By Henry Muller, Chairman

The new slate of officers for the 1951-52 term was announced at the May 23rd meeting of this section (See Section Officers Listing).

C. H. Foster of the Philadelphia Section, who was a guest at this meeting outlined an industrial training course which his group planned to sponsor later this year.

Dr. C. W. Kelley of the Munitions Board, Office of Petroleum Programs, presented a paper on the consolidation of military lubricants. His talk covered the functions of the Office of Petroleum Programs and the Standards Agency in shaping lubricant specifications for the military services. Specific examples covering the consolidation of specifications for rust preventives, aircraft greases, heavy duty engine oils, etc., were given.

Ed. Note: Consolidated Military Lubricant Standards and Specifications is published in full on page 184 of this issue.

PHILADELPHIA

By Wm. Eismann, Jr.

"Hydraulic Fluids—Simplified," by C. R. Schmitt, Manager, National Lubrication Sales, E. F. Houghton & Co.—May meeting.

Ed. Note: This article is printed in its entirety beginning on page 168 of this issue.

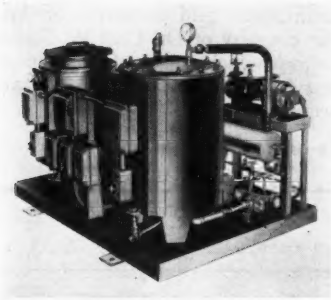
PITTSBURGH

By M. C. Miller, Secretary

"The Influence of Solid Surface Films on the Friction of Steel at High Sliding Velocities," by E. E. Bisson—May meeting.

(*Continued on page* 198)

LUBRICATION IN THE NEWS



OIL CONDITIONER UNIT: Specifically designed for small-batch clarification of used hydraulic, lubricating, run-in and transformer oils a 25-40 GPH oil conditioner unit has been placed in production. Both insoluble and soluble impurities are reported to be completely removed by the unit which contains a cartridge filter and vaporizer.

Prior to the introduction of this particular unit, the advantages claimed for it were available only in the company's larger size models to users having 50 to 600 GPH flow rate requirements. The cartridge filter and vaporizer which form the unit are mounted on a common base, portable if desired, and are complete with all necessary electric and pump connections. Filter and vaporizer may be operated singly or together. Further details may be obtained by writing the manufacturer.

U. S. Hoffman Machinery Corp.
Filtration Division
219 Lamson St., Syracuse 6, N. Y.

OILER BROADSIDE: This four-page booklet "Series 4900" was designed to aid lubrication and maintenance men in selecting the proper visible, automatic oiler for constant level, gravity, wick, underfeed, multiple and large capacity gravity feed applications. It contains suggestions on how to increase production—reduce maintenance costs—lengthen machine life—cuts costs, etc. For free copy write the manufacturer.

Trico Fuse Mfg. Co.
2948 N. 5th St., Milwaukee 12, Wis.

CUTTING FLUID: A new high film strength water soluble transparent cutting fluid has recently been put on the market under the trade name of TUFF-KUT. Some of the features claimed by the manufacturer are its clear transparency — smokeless and odorless — contains no petroleum oil — and is said to give excellent protection against rust on machined parts and to be exceptionally effective in drilling, milling, tapping and threading operations.

Test quantity samples available by writing the manufacturer.

Lubricants Inc.
908 Fisher Bldg., Detroit 2, Mich.

KNITTING LUBRICANT: "Sunotex Machine Oil & Sunotex Machine Oil Light," a revision of a former publication, describes a new lubricant for needles, sinkers and supplementary parts of all kinds and makes of knitting machinery. The manufacturer claims savings and improvements in operations by reducing needle wear and breakage and by keeping all parts rust free. Free copies are available by writing the manufacturer.

Sun Oil Co.
1608 Walnut, St., Philadelphia 3, Pa.

MAINTENANCE SHOW: The 1952 Plant Maintenance Show will be held at Convention Hall, Philadelphia, January 14-17.

The exposition, held for the first two years in Cleveland, has been moved to Philadelphia to permit greater attendance from the eastern industrial area.

The displays are expected to cover an area almost four times that of the first show, held in 1950. More than 200 companies are expected to participate. One hundred and fifty-six firms already have contracted for exhibit space.

The Plant Maintenance Conference will be held concurrently with the show. L. C. Morrow, consulting editor, *Factory Management and Maintenance,* will serve as general chairman.

ASLE, as in the past, will sponsor the annual Lubrication Panel which last year attracted an audience of 1500.

Professor Wilson P. Green, Armour Research Foundation, Chicago, will act as chairman of the session. Professor Green's position at Armour is Chairman of Heat-Power Research Department, which consists of the Engine and Lubricants group and the Fluid Mechanics and Thermo Dynamics group. He will be assisted by six panel members chosen from industry for their practical knowledge and approach to lubrication engineering and related subjects.

Advance registration cards and hotel information may be obtained by writing Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y.

PERSONALS

Dr. John T. Burwell, Jr., Associate Professor of Mechanical Engineering at Massachusetts Institute of Technology, has resigned to accept a position with HORIZONS, INC., at Princeton, N. J. and Cleveland, Ohio, with headquarters in the latter city. The firm is engaged in industrial research. Dr. Burwell will become assistant to the Vice President in charge of research.

Dr. Burwell received his B.S. and Ph.D. degrees in Physics from M.I.T. His particular fields of teaching and research were in lubrication, and friction and wear.

Dr. Burwell bears the further distinction of having conducted the first Lubrication Engineering Summer Course which was recently completed at M.I.T. under the sponsorship of ASLE.

He is a member of the Sub-Committee on Lubrication and Wear of the National Advisory Committee for Aeronautics and Chairman of the Technical Committee on Lubrication Fundamentals of ASLE.

New Vice-Presidents: F. H. McCurdy, President of the Brooks Oil Company, has announced the election of two new Vice Presidents, which took place at the Company's 75th Annual Stockholders and Directors meeting.

J. A. Rigby was named Vice-President in Charge of Engineering and Sales. His prior position was Manager of Engineering and Sales. He is a member of the AISE, ASLE, NLGI and ESWP.

H. W. Winkler was elected Vice-President in Charge of Research and Laboratory Control. Prior to this position he was Chief Chemist. Mr. Winkler was associated for many years with Dr. P. H. Conardson in the development of testing techniques for petroleum lubricating oils and greases. Mr. Winkler is a member of the NLGI.

CONSOLIDATED MILITARY LUBRICANT STANDARDS AND SPECIFICATIONS

The following tabulated consolidation of information on major military specifications and standards on lubricants, of interest to both consumers and producers, has been supplied through the courtesy of Dr. Carl W. Kelley of the Munitions Board, Office of Petroleum Programs. Information as to sources from which copies of these specifications can be obtained follows the tabulation. The Office of Petroleum Programs has indicated that all military information on lubricants will be made available to industry to the extent that security permits.

Information on Major Military Specifications and Standards on Lubricants

ITEM NAMES	SPECIFICATION NUMBERS: CURRENT OR IN PROCESS	SPECIFICATION NUMBERS: SUPERSEDED OR TO BE SUPERSEDED	CUSTODIAN	REMARKS
CORROSION PREVENTIVE:				
Aircraft Engine (Heavy Oil)	MIL-C-5545A	AN-C-178	AER	5-hour engine test. In process.
Aircraft Engine	MIL-C-	AN-VV-C-576b	USAF	50-hour engine test. In process.
Engine	MIL-C-	2-126	ORD	36-hour engine test.
Fingerprint Remover	MIL-R-15074	AF-14156A (1) MIL-R-15074 (Ships) EES-C-3348; AXS-1719	AMC	Performance specification AMC qualifying.
Food Handling Equipment	MIL-C-10382	MIL-C-10382 (Ord) (2)	ORD	Petrolatum and Microcrystalline Wax in P-S-661.
Lubricating Oil Preservative, Light	MIL-L-3503	14-L-17 OS-1362	BUORD	
Lubricating Oil	MIL-O-6084	AN-O-10		Cancelled.
Lubricating Oil, Medium	MIL-L-3150	2-122; 14-O-17; OS-1363	ORD	
Petrolatum Type, Hot Application	MIL-C-15167	AXS-1347; 2-84 52-C-17Ty. B & C 14-C-8; AN-C-124Ty. LL MIL-C-6708 Ty. 2; 2-82 MIL-C-15167 (Ships) (1)	ORD	Three grades of pigmented and non-pigmented. In process.
Solvent Cutback, Cold Application	MIL-C-16173	MIL-C-16173 (Ships) 52-C-18 Gr. 1, 2 and 3 14-C-9; AN-C-124 Ty. 1 AXS 1759 Gr. 1 and 2 MIL-C-972 (Ships) (1) MIL-C-6708 Ty. 1, AXS-673	SHIPS	Three thicknesses of film. Will be coordinated. Ships are qualifying.
Soluble Oil	MIL-C-	AF-3604A	USAF	In process.
CUTTING OIL, Soluble	VV-C-846	VV-O-261	FED	
CUTTING OIL, Sulfurized	VV-C-	14-C-10 (Ord)	BUORD	
CUTTING PASTE	MIL-C-	14-C-11 (Ord)	BUORD	In process.
DRUMS, Steel, Petroleum	RR-D-729a (L)		FED	
FLUID:			USAF & AER	
Calibrating Aircraft Meters	MIL-F-7024 (1)			
Damping, Ester Base	MIL-F	51-F-24 (Ord)	BUORD	In process.
Hydraulic		51-F-23 (Ord)	BUORD	To be superseded by 51-F-21.
Hydraulic, Aircraft, non-inflammable	MIL-F-7083 (AER)	51-F-22 (AER)	USAF	Hydrolube type.
Hudraulic, Aircraft, non-inflammable	MIL-F-7100		AMC	Performance specification.
Hydraulic Brake	MIL-F-2111	2-111B	ORD	Non-mineral oil type.
Hydraulic Brake, Arctic	MIL-F-	2-138	ORD	
Hydraulic, Castor Oil Base		AF-3586-C	USAF	
Oil, Fog	MIL-	14-F-3 (1)	CMLC	In process.
Power Transmission	MIL-	51-F-21 (Ord)	BUORD	
Reference, Shear Stability	MIL-F-5602	AN-F-43	USAF	
Shock Absorber	JAN-F-461	2-112A	ORD	
GEAR LUBRICANT:				
Low Temperature	MIL-O-6086	AN-O-3 (6)	USAF	Cover sheet.
Universal, Sub-zero	MIL-L-10324	MIL-L-10324 (Ord) (2)	ORD	In process.
LUBRICATING GREASE:				
Aircraft, Low and High Temperature	MIL-G-7118 (1)	AN-G-10	AER	Printed.
Aircraft and Instruments	MIL-G-3278 (1)	AN-G-25; 2-134	AER	In process.
Automotive and Artillery	MIL-G-10924	MIL-G-10924 (Ord) MIL-G-2108; 2-108; 2-39 AXS-785; 2-106; AXS-781; AXS-1169; 14-G-10; 14-G-3c		
Automotive and Industrial	VV-G-632		FED	
Extreme Pressure	MIL-L-	14-G-9 (Ord); 2-118		AMC will rev.
Gasoline and Oil Resistant	MIL-L-6032	AN-G-14a	AER	In process.
General Purpose, Aircraft	MIL-L-7711	AN-G-15a (1)	AER	In process.
Graphite	VV-G-671c	VV-G-671b	FED	
Graphite	MIL-G-7187	AN-G-6a (1)	AER	Being printed.
High Temperature	MIL-L-	AN-G-5; 14-G-11 14-L-7	AER	Being coordinated.
High Temperature Bearing	MIL-G-15719	MIL-G-15719 (Ships)		
Instrument, Low Temperature	MIL-G-15793	MIL-G-15793 (BUORD) (1)	BUORD	
Locomotive	VV-G-679	VV-G-651; VV-G-661	FED	Printed.
Pneumatic System	MIL-L-	AF 3515	USAF	In process.
Scupper Valve	MIL-L-	14-L-6		
Shell	MIL-L-	50-11-37A (1)	ORD	
Torpedo Tail	MIL-L-	14-G-11 (Ord)	BUORD	
LUBRICATING OIL:				
Compounded, Cylinder	MIL-L-15019A (1)	NBS 431		
Compounded, Cylinder	VV-O-601			
Engine, Aircraft	MIL-O-6082 (1)	AN-O-8	AER	Initiated.
Engine, Arctic	MIL-O-10295	MIL-O-10295 (Ord)		Initiated.
General Purpose	MIL-L-15016A (2)	NBS-431		
General Purpose, Low Temperature	MIL-L-	AN-O-6	USAF	Initiated.
Graphite	MIL-L-	14-L-13		
Gyroscope, Torpedo	MIL-L-	14-L-14 (Ord)		
Heavy Duty, Diesel	MIL-L-9000	14-O-13a		To be initiated.
Heavy Duty, Engine	MIL-O-2104	2-104B		To be coordinated.
Hydraulic	MIL-O-5606 (2)	MIL-O-5606 (1), 2-132	USAF	Being investigated.
Hydraulic	MIL-L-15017 (1)	14-O-	SHIPS	
Hydraulic, Aircraft	MIL-O-6083A	2-79	USAF	Preservative.
Instrument	MIL-O-6085A	14-O-20 (Ord)		Being studied.
Jet Engine	MIL-O-6081A	AF-3519; AN-O-9 MIL-O-6081	USAF	Has 1005 and 1010 grade.
Jewel Bearing	MIL-L-	14-L-16 (Aer) 2-47; OS-1346	ORD	Under study.
Light	MIL-L-	2-27F		Preparing.
Mineral, Cylinder	MIL-L-15018A(1)	NBS-431		
Mineral, Cylinder	VV-O-611			

ITEM NAMES	SPECIFICATION NUMBERS: CURRENT OR IN PROCESS	SPECIFICATION NUMBERS: SUPERSEDED OR TO BE SUPERSEDED	CUSTODIAN	REMARKS
LUBRICATING OIL—Cont.				
Penetrating	VV-P-216	O-26-(3)		In process.
Preservative, Special	MIL-L-644B	MIL-L-644A (1)	ORD	To be cancelled later.
Recoil, Light	MIL-L-	2-360		
Refrigerator	VV-O-581a	VV-O-581; 2-124 (1)		In process.
Synthetic Base	MIL-L-6387	MIL-L-6387 (USAF)	BUORD	
Tail Packing	MIL-T-3123	14-T-2		
Traction Motor	MIL-L-	2-133	SHIPS	
Turrent, Roller and Pinion	MIL-L-	14-L-8	SHIPS	
Turbine	MIL-L-	14-O-15 (1)		Under study.
THREAD COMPOUND, Anti-seize	MIL-T-	2-119; MIL-C-5544 52-C-14		

(Note: Number in parenthesis is amendment number.)

Sources of Supply for Copies of Specifications

U. S. Air Force Specifications: Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio. Attn.: MCREXU61.

U. S. Army Specifications: Office, Chief of Ordnance, Department of the Army, Washington 25, D. C.

U. S. Navy Specifications: Bureau of Supplies and Accounts, Department of the Navy, Washington 25, D. C.

Air Force-Navy Aeronautical Specifications: Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio. Attn.: MCREXU61.

Federal Specifications: Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Additional Information

Orders for a new series of indexes of military specifications are now being accepted by the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Actual delivery date is uncertain at this time. The names and prices of the four volumes comprising the series are:

a. "Index of Military Specifications and Standards, Military Index, Volume I." Price, $2.75.

b. "Index of Specifications and Standards, Department of the Army, Military Index, Volume II." Price, $2.75.

c. "Index of Specifications and Standards, Department of the Navy, Military Index, Volume III." Price, $2.50.

d. "Index of Specifications and Standards, Department of the Air Force, Military Index, Volume IV." Price, $2.75.

(Cumulative monthly supplements are included in the above prices for the current indexes.)

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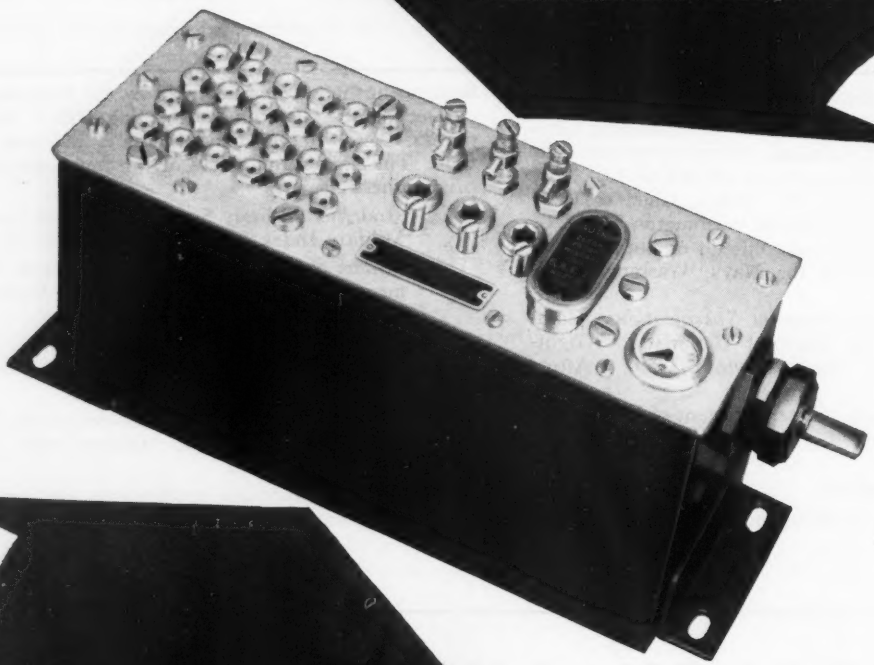

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CURRENT LITERATURE

Chemical Industries Week, Vol. 68, No. 18, May 19, 1951.

SLICKER, COOLER, CUTTING

Anon.—P. 31

It is estimated that consumption of cutting oils is 60 million gallons per year. These fluids are of two general types: cutting, or straight, oils; and soluble oils (actually emulsions). Straight oils for severe machining require additions of extreme pressure additives. Where a machining operation requires cooling action more than lubrication, so-called soluble oils are used. These aqueous emulsions depend on water, an ideal coolant, to dissipate the heat. Petroleum sulfonates are the principal emulsifiers used in these products, but sodium and potassium rosin soaps, amine soaps of rosin acids and fatty acids are also employed. Rust inhibitors, germicides, foam depressants and additives for freeze-thaw stability are other ingredients.

No. 19, May 26, 1951

ALL-TEMPERATURE GREASE

Anon.—p. 6

Tests of a new all-temperature grease, developed by the Army Ordnance Corps, are being run. Lubricant is claimed to be suitable for temperatures from —65 to 125 F. Composition is not given.

Chemical Processing, Vol. 14, No. 4, April, 1951

PAPER CITES SAVINGS, BETTER EQUIPMENT OPERATION WITH SYNTHETIC LUBRICANTS. COMPOUNDS ARE ALSO USED AS ANTI-FOAMERS, DETERGENT ADDITIVES, FIBER CONDITIONERS, IN PRINTING INKS

Anon.—p. 37

One group of these synthetics — the polyalkylene glycols and derivatives—has the combined properties of excellent antiwear action, good load-carrying capacity, favorable viscosity-temperature relationships, low stable pour points, little or no solvent and swelling effect on both natural and various types of synthetic rubber, stability at elevated temperatures, and unusual resistance to sludge and varnish formation. (From paper presented by C. H. Sweatt and T. W. Langer before the 71st Annual Meeting of the American Society of Mechanical Engineers in New York.)

Chemie Ingenieur Tecknik, Vol. 23, No. 7, April 14, 1951

THE EVALUATION OF SYNTHETIC LUBRICANTS

Goettner, G. H.—pp. 157-160

At full lubrication the interrelationship between temperature and viscosity is of great importance. Special systems of index numbers have been developed to characterize this magnitude. They are mostly based on the observation of the behavior of petroleum products. They fail, however, when lubricants of very low viscosity are to be evaluated, or oils with a very flat or very steep viscosity-temperature curve or oils of high density. The author develops a new index number which he thinks will be especially useful in guiding the scientist and technician in producing new synthetic lubricants of defined properties.

Corrosion, Vol. 7, No. 4, April, 1951

SURFACE ATTACK OF METALS BY FATTY ACIDS AND THE FORMATION OF LUBRICATING LAYERS

Tabor, D. and Tingle, E. D.—p. 66A
(Surface Chemistry (Special Suppt. to Research), pp. 217-220, 1949, (in English).

The paper shows that on non-reactive surfaces, such as silver or platinum, fatty acids (polar bodies) are no more effective as boundary lubricants than paraffins or alcohols of about the same chain length, i.e., they produce a low-coefficient of friction only when solid. Lateral adhesion between the lubricant molecules is of great importance and physical adsorption of lesser importance in reducing friction. It is suggested that metallic soap films are not formed by direct reaction with the metal, even with electro-negative metals, nor with the oxide film in the absence of water, but that for adequate soap formation the presence of water during the formation of the oxide film is necessary.

Diesel Progress, June, 1951

EXCHANGE YOUR DIESEL MAINTENANCE IDEAS; ADDITIONAL MAINTENANCE PROBLEMS

Gregory, R. L.—p. 66

No matter how religiously you follow a maintenance program and how often you check equipment, conditions will arise in parts and manufacturing methods over which you have no control, that will affect daily operation. Faulty equipment is often a cause of trouble. The trouble may also be fuels or lubricants. The article is chiefly confined to unforeseen difficulties.

Esso Oilways, Vol. 17, No. 12, June, 1951

UNIVIS IN UNIFORM

Anon.—pp. 16-19

Manufacturing plants working on war products again can turn to Univis Oils as hydraulic mediums of very high viscosity index. Approved by U. S. Government agencies these oils are particularly useful in machines operating over wide temperature ranges. In 1936, for the first time, the Esso Laboratories succeeded in producing oils with a viscosity index of 150, and in subsequent years it has developed oils with a viscosity index of at least 225. All bear the brand name Univis, derived from the words "uniform" and "viscosity." But outstanding viscosity index does not alone fit these products for these uses. They are all characterized by excellent oxidation resistance and exceptionally low pour points. Several grades contain additives to increase lubricity, and in some grades corrosion inhibitors are present.

Fuel Abstracts, Vol. 9, No. 3, March, 1951

LUBRICATION, MAINTENANCE AND INSPECTION OF BELT CONVEYORS #1462

Anon.—p. 5

(Min. Congr. J. Vol. 36, No. 12, pp. 31-34, Dec. 1950)

SOME INDUSTRIAL EXPERIENCES WITH SYNTHETIC LUBRICANTS #1756
Sweatt, C. H. and Langer, T. W.—p. 60
(Amer. Soc. Mech. Engrs. Prepr. 50-A-139, Dec. 1. 1950)

Experiences with synthetic lubricants are described in detail to illustrate service in which the polyalkylene glycols may prove advantageous.

MAXIMUM SHEAR AND LIMIT OF RESISTANCE OF LUBRICANTS DURING EVALUATION OF THEIR MECHANICAL PROPERTIES # 1737
Trapeznikov, A. A. and Zakieva, S. Kh.—p. 55
(Doklady Akad. Nauk S. S. S. R. (Rep. Acad. Sci. U. S. S. R.) July 21, 1950—pp. 519-522)

Industry and Power, Vol. 60, No. 5, May, 1951

PURIFY LUBE OIL . . . AND LOWER OPERATING COSTS

Gottlieb, W. H.—p. 95

A meat packer, Cudahy Brothers, Inc., is effecting a net saving of more than $1500 a year through use of a purifier to reclaim a wide variety of lubricating oils. To handle purification of the various lubricants, the company has set up a flexible batch treatment center with a purifier, motor-driven transfer pump, three contaminated-oil tanks and eight elevated clean-oil tanks.

Institute Spokesman, Vol. 14, No. 12, March, 1951

COMPLEXES IN LUBRICATING OIL GREASES

Arnott, E. and McLennan, L. W.—pp. 7, 9 11-13, 15-17, 19, 21, 23

In this paper the authors have chosen to refer to the soap modifications, i.e., hydrated soaps, basic soaps, and soaps associated or combined with various other polar compounds, as complex soaps. Formulations and properties of the soap complexes which are discussed, include lead soap-lead glyceroxide, barium soap-barium acetate, calcium soap-calcium acetate, calcium soap-calcium chloride, and calcium soap-calcium carbonate. Tables compare certain of these soaps with certain of these complexes.

DISCUSSION OF COMPLEXES IN LUBRICATING OIL GREASES

Swenson, R. A.—p. 24

The extended use of modified soap structures in grease manufacture during the past 15 years is briefly reviewed.

SULFONATE BASE LUBRICATING GREASES

Anon.—p. 31

In U. S. Patent 2,535,101, Standard Oil Development Company discloses the preparation of suitable lubricating greases by employing an appropriate quantity of a relatively high molecular weight metal sulfonate in combination with a relatively small amount of a lower molecular weight and relatively oil-insoluble metal sulfonate.

Vol. 15, No. 2, May, 1951

NATIONAL LUBRICATING GREASE INSTITUTE DISPENSING TEST

Roehner, T. G.—pp. 7, 9, 11, 13

This test is a part of a method for rating grease dispensing equipment in terms of the properties of the greases it will dispense. In its present form it is limited to tests in 100-pound drums and to automotive greases. The test provides for measuring the delivery rate under conditions of free flow and restricted flow over a range of temperature. Thus this part of the method provides information on the overall action of the gun and grease since it deals with conditions on both the slumpability or suction side and the pumpability or pressure side of the equipment.

"A STUDY OF RUST PREVENTIVE PROPERTIES OF GREASES"

Burger, R. J. and Rubin, B. and Glass, E. M. —p. 32

An investigation of rust preventative properties of greases, carried out at Wright Field, resulted in the development of a static humidity cabinet test procedure for evaluating rust preventive properties of greases which apparently gave a high degree of correlation with actual field service experience. This procedure involved packing 204K bearings with the test grease and suspending the specimens in a humidity cabinet maintained at 100 F. and 95% relative humidity. The bearings were inspected periodically for evidence of rusting. (Abstract of paper presented at the Annual Meeting of the American Society of Lubrication Engineers).

"HIGH SPEED, HIGH TEMPERATURE GREASE APPLICATIONS"

Erck, E. H.—p. 32

Numerous slides were shown of accessory and instrumentation equipment which is used in present day aircraft. Several new aircraft developments were touched upon with involved speeds as high as 60,000 rpm and temperatures in excess of 400 F. (Abstract of a paper presented at the Annual Meeting of the American Society of Lubrication Engineers).

Journal of Applied Physics, Vol. 22, No. 4, April, 1951

LUBRICATION AT EXTREME PRESSURES WITH MINERAL OIL FILMS

Clark, O. H., Woods, W. W., and White, J. R. —pp. 474-483

Intact mineral oil films at average pressures ranging from 86,000 to 215,000 psi and at high rates of shear have been obtained using a bearing consisting of the contact area between crossed axis steel cylinders. The lubricating films possess the shearing properties of plastic solids, a fact which is consistent with solidification observations reported in the literature of high pressure viscometry. The observation of complete mineral oil lubrication at such extreme pressures resulting from known bulk properties, namely, viscosity increase and solidification under pressure, suggests that these properties are sufficient to account for practical mineral oil lubrication.

Journal of the Institute of Petroleum, Vol. 37, No. 326, February, 1951

VISCOSITY-TEMPERATURE CHARACTERISTICS OF LUBRICATING OILS

Kusakov, M. M.—p. 96A
(Petroleum, Vol. 12, No. 7, pp. 170-4, July, 1949) (Translated from Symposium on the Viscosity of Liquids and Colloidal Solutions, Academy of Sciences of the U. S. S. R.)

It is proposed to utilize the Vogel-Fulcher-Tammann formula for variation of viscosity with temp. The three constants of this formula have a precise physical meaning, and enable both the visc level and slope of the visc-temp curve to be conveniently defined.

BETTER LUBRICATION FOR DIESELS

Eltham, B. E.—pp. 96A-97A

(Mech. World, Vol. 128, No. 3333, p. 517, Dec. 12, 1950)

High viscosity index oils having suitable detergent additives are recommended.

Journal of Research (National Bureau of Standards), Vol. 46, No. 4, April, 1951

STATIC FRICTION TESTS WITH VARIOUS METAL COMBINATIONS AND SPECIAL LUBRICANTS

White, H. S. and Zei, D.—pp. 292-298

Special lubricants, such as chlorinated and fluorinated hydrocarbons, were compared with a reference mineral oil. The effect of additives, such as graphite, molybdenum disulfide, zinc oxide, boron nitride, and an oxidized petroleum compound, was investigated. It was found that the special chlorinated and fluorinated lubricants without additives gave higher friction than the Navy symbol 2110 reference oil. A lubricant containing the oxidized petroleum compound and one containing a silicone grease gave slightly less friction than the reference oil. With a mineral lubricating grease, with dry molydenum disulfide, and with lubricants containing graphite or molybdenum disulfide, the friction was about 50 per cent less than with the reference oil.

Laboratory (Fisher Scientific Company), Vol. 20, No. 3, 1951

ZAHN VISCOSIMETER MAKES VISCOSITY TESTS IN 30 SECONDS

Anon.—p. 74

To take a reading, the cup is merely lifted out of the liquid and as it leaves the surface a stop watch is started. The liquid flows through the calibrated orifice in the bottom of the cup. When the stream suddenly breaks, the time is noted. Time or flow, which is usually less than one minute, is recorded in Zahn seconds. If desired, this can be readily converted to centipoises.

Lubrication Engineering, Vol. 7, No. 2, April, 1951

GEAR OIL ADDITIVES

Brewer, A. F. and Keating, P. J.—pp. 58-64

The extensive use of additives in gear oils is not new. Actually it began about 1930. The first petroleum gear lubricants were simply the residual products derived from refining straight mineral oils. To understand where film strength fitted in, types of lubrication must be discussed: thick film or hydro-dynamic lubrication and boundary lubrication. Gear failure may be caused by poor metal structure, faulty design, abuse, overloading, etc. Lubricants which would otherwise be amply protective cannot insure against failure under such conditions, nor can they always keep the temperatures within reasonable limits. Wear, scoring, and galling, welding, pitting, etc., are taken up. For lubrication to be effective an ample film of lubricant must be kept on the worm and gear teeth to prevent wear. When used under high-speed conditions, or wherever the gears may come into contact with water, acids, alkalis, or chemical fumes, the gear teeth may lose their protective film of lubricant, due either to its being thrown off by centrifugal force, or washed from the wearing surfaces. A tabulation of gear oil additive types is given in table 1.

NATIONAL LUBRICATING GREASE INSTITUTE GRANTS FELLOWSHIP

Anon.—p. 64

Mr. Howard Cooper, President of the National Lubricating Grease Institute, announces that a National Lubricating Grease Institute Fellowship has been granted to the University of Southern California. Its general scope will include the study of the fundamental physical chemical basis on the observed behavior of lubricating greases.

LUBRICATION, ITS IMPORTANCE TO PLANT FIRE SAFETY

Shepherd, R. G.—pp. 68-9

An analysis of almost 20,000 industrial fires rated friction as the second most important cause (14% of total), being exceeded only by electrical failures. Lack of proper lubrication is the direct cause of most fires caused by friction. For example a survey of over 200 prominent southern cotton mills during 1944-45 disclosed that over 40% had never had a lubrication survey made. These mills averaged over 30% more fires. Any plant supporting a highly efficient lubrication procedure is invariably a safer plant.

LUBRICATION PANEL

Anon.—p. 70

The American Society of Lubrication Engineers participated in the recent Plant Maintenance Show at Cleveland, Ohio. This second Lubrication Panel, which attracted an audience of over 1,500 people, attests to the growing awareness of the need for information on the subject of proper lubrication.

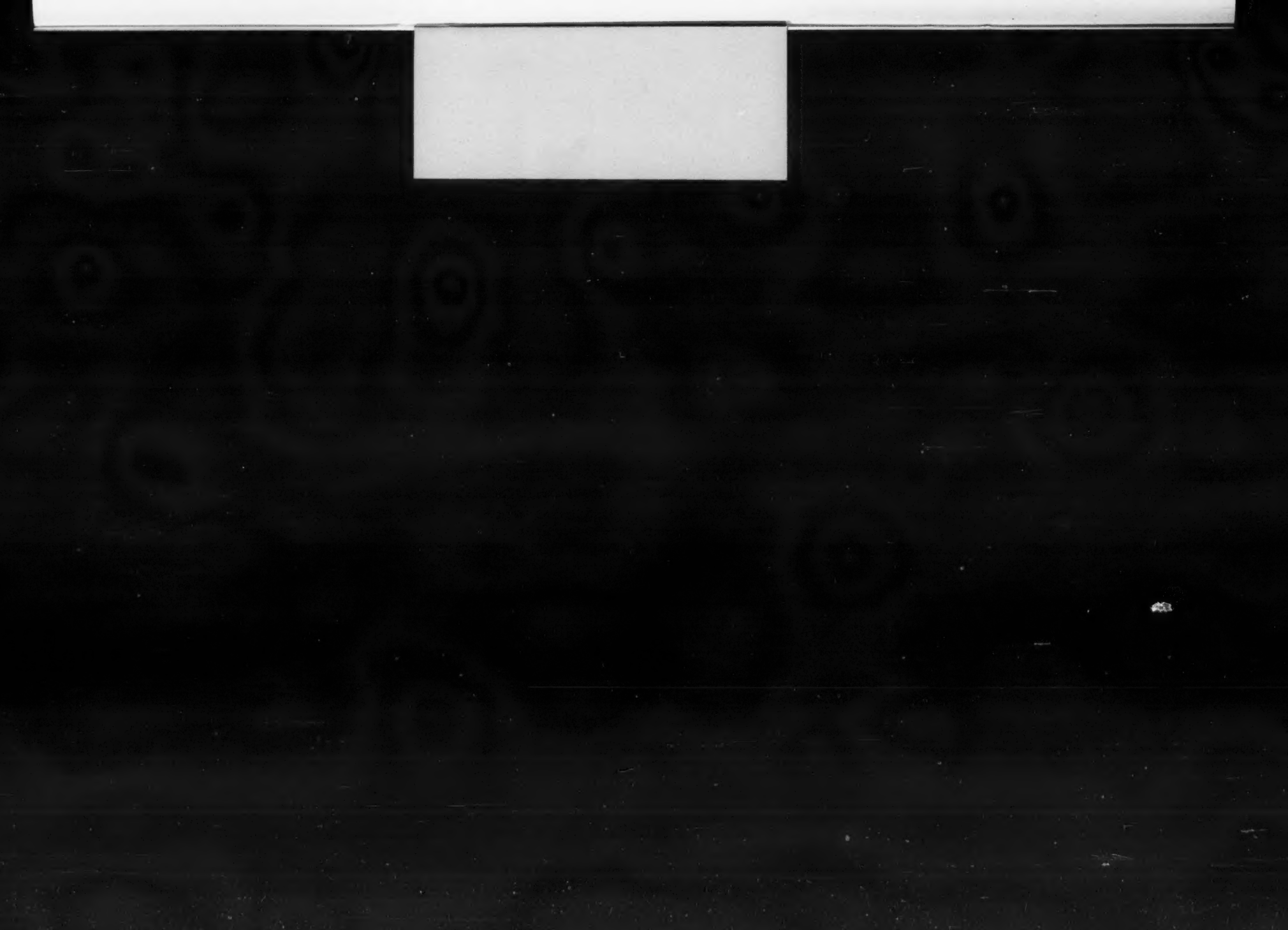
SOMETHING NEW HAS BEEN ADDED

Anon.—p. 95

(Flying Red Horse, Vol. 16, No. 4, Autumn 1950, pp. 26-30)

Before the use of additives reached any considerable proportions, refiners sought to improve oils through "subtractive" processes. These consisted of trying to remove undesirable qualities from lubricating oils. Refiners treated lubricating oils with sulfuric acid, or filtered the oil through clays. Methods were devised to remove wax from oil.

(*Continued on page* 198)



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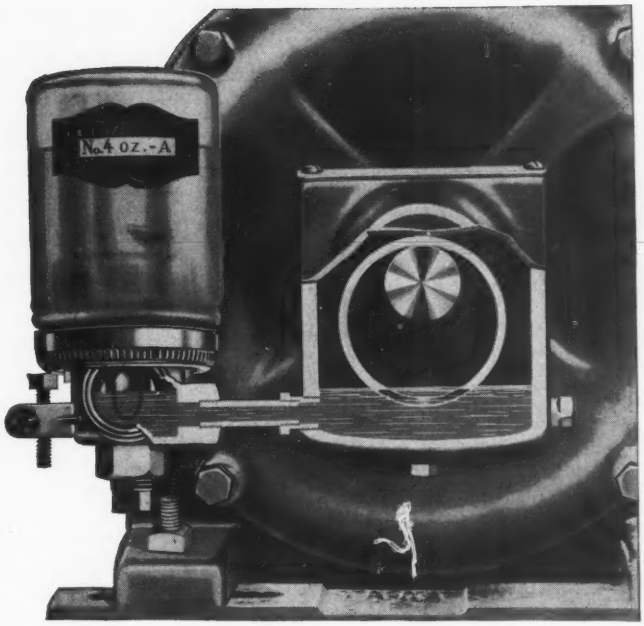
Prove it to yourself. Install one Acro Constant Level Lubricator and make your own comparison. Others have done this and ordered lubricators for additional machines, equipment, etc., and for new equipment as installed. Two such case histories are shown at the right. Write for free bulletin.



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		3-15-49	14-4 oz. "
April 4, 1950	12-4 oz. "	7-18-49	45-4 oz. "
April 19, 1950	144-4 oz. "	8-5-49	90-4 oz. "
June 5, 1950	144-4 oz. "	8-23-49	170-4 oz. "
July 17, 1950	144-4 oz. "	9-26-49	174-4 oz. "
		11-23-49	27-4 oz. "
*NAME ON REQUEST		12-5-49	12-4 oz. "
		3-3-50	390-4 oz. "
		9-21-50	82-4 oz. "

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1952 ANNUAL MEETING HI-LITES

Plan now to attend the 1952 ASLE National Meeting
to be held at the Hotel Statler in Cleveland

APRIL 7, 8 and 9

The contemplated program will have greater coverage, variety and balance than any in the history of ASLE

INNOVATIONS FOR 1952

COVERAGE: *Three simultaneous Sessions on certain days instead of the usual two, to provide greater coverage.*

VARIETY: *The newly organized Technical Committees will provide a substantial portion of the program material. The new Industry Relations Committee will also contribute.*

BALANCE: *When three simultaneous sessions are held it is planned that two will be devoted to practical papers and one to research papers.*

Here are some detailed HI-LITES on the material now being organized by the new Technical Committees

BEARINGS

A symposium on the fatigue of bearings is planned, under the sponsorship of the Technical Committee on Bearings and Bearing Lubrication. This will cover such subjects as Introduction to Bearing Fatigue, Fatigue Testing of Bearings and Bearing Materials, Fatigue Properties of Bearing Materials, and Influence of Bearing Design on Fatigue Performance. Papers on sliding type bearings and rolling type bearings will also be sponsored.

LUBRICATION ECONOMICS

The Technical Committee on Lubrication Economics is planning a panel session, the panel to be made up of men with good practical experience in this field.

LUBRICATION EQUIPMENT

Among several papers being sponsored by the Technical Committee on Lubrication Equipment will be an outstanding paper on Lubrication in the Steel Industry from Management's Point of View.

HYDRAULICS

The Technical Committee on Hydraulics and Hydraulic Machinery is organizing a session of papers from representatives of each major phase of hydraulics; namely, the Hydraulic Equipment Manufacturer, the Machine Tool Builder and the User. Presentation of the papers may be followed by a forum with full audience participation.

DISPOSAL OF LUBRICANTS

A session of papers on the important subject of Disposal of Lubricants is being organized by the Technical Committee on Lubricant Reclamation and Disposal.

OTHER CONTRIBUTIONS

Important papers on Lubrication Fundamentals, Physical Properties of Lubricants and Fluids for Metal Working are now being developed by the corresponding Technical Committees, for sponsorship on the 1952 program.

Watch for additional Hi-Lites of the 1952 ASLE Annual Meeting in future issues

PLAN NOW TO ATTEND

Every Minute Meant a $1920 saving

Big return for a minute's time . . . but to a leading Philadelphia manufacturer* a 5 minute interview did result in a total saving of $9600.

This manufacturer faced a problem that's common to many plants today. His ten machines have 560 bearings—560 bearings that must be kept lubricated if production is to be kept uniform, rejects few. That lubrication job was taking four man hours every week and, because of human fallibility, there was always the potential danger that one of these many bearings had been overlooked or under lubricated.

An Alemite Lubrication Engineer was called in. He made his presentation in just 5 minutes—5 minutes that saved $9600. He told the manufacturer the facts of installing a modern Alemite Centralized Lubrication System. That system is in the plant today. The result: assurance of continuous, correct lubrication, few rejects and shut downs, and the addition of a whole hour's production time every working day.

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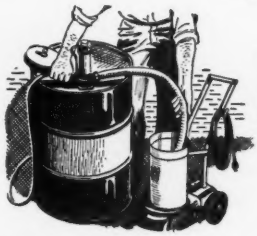

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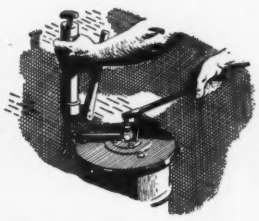
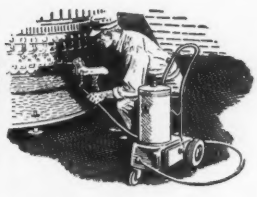


2. In loading grease guns . . . saves 3¾ man hours for every 100 pounds of lubricant loaded into hand guns.



3. In applying lubricants . . . saves up to 23.9 man hours for every 100 pounds of lubricant applied to bearings.

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Lubrication Engineering

A SEMINAR UNDER THE DIRECTION OF PROFESSOR J. T. BURWELL, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The program was designed principally for the plant maintenance engineer—that is to say, for the user who actually faces immediate practical problems in lubrication from day to day, and must tackle them successfully if shutdowns and work stoppages are to be avoided. For this reason, the technical level of the course was kept as pragmatic as possible, discussion of theory being included for general background when necessary. Considerable interest in the course was expressed by lubricant sales engineers, and indeed by manufacturers of lubricants. This was naturally a matter of satisfaction to those in charge of the program; it was felt, however, that the greater need for this material in the industry lay with the user—that is, the purchaser, rather than the maker or purveyor of lubricants. In fact, it was borne in mind that the majority of oil companies have presented comparable material in training courses for their own personnel and that, therefore, in the selection of registrants, effort should be made to avoid duplication of work already accomplished.

Schedule

MONDAY, JUNE 11: Introductory remarks and organization of the course by Prof. J. T. Burwell, followed by a lecture on the Principles of Full Fluid Lubrication by Prof. Burwell.

TUESDAY, JUNE 12: Bearing Design by Mr. John Boyd, Westinghouse Electric Corp., followed by a visit to Sloan Automotive Laboratory and a continuation of Mr. Boyd's discussion.

WEDNESDAY, JUNE 13: Principles of Dry Friction and Boundary Lubrication by Prof. Burwell.

THURSDAY, JUNE 14: Bearing Materials and Surface Finish by Prof. Burwell.

FRIDAY, JUNE 15: Fluid Lubricants—Constitution, Properties and Standard Tests, by Prof. J. I. Clower, University of Delaware. . . . Panel Discussion on Deterioration and Reclamation of Lubricants by Prof. Clower and Mr. Wayne Lasky, Gulf, Mobile & Ohio Railroad.

MONDAY, JUNE 18: Greases—Their Characteristics and Applications, by Mr. G. W. Miller, Battenfeld Grease & Oil Corp. . . . Solid Lubricants, by Prof. Burwell.

TUESDAY, JUNE 19: Hydraulic Systems, by Mr. Kenneth Court, Vickers, Inc. . . . Cutting Fluids, by Prof. M. C. Shaw, Massachusetts Institute of Technology.

WEDNESDAY, JUNE 20: Ball, Roller and Needle Bearings, by Mr. C. R. Gillette, New Departure Division, General Motors Corp., followed by a general discussion period on the material thus far covered, led by Prof. Burwell.

THURSDAY, JUNE 21: Lubricating Appliances and Systems, by Mr. C. E. Pritchard, Republic Steel Corp., followed by a general discussion of the topic, led by Mr. Pritchard.

FRIDAY, JUNE 22: Plant Maintenance, by Mr. C. L. Pope, Eastman Kodak Co. . . . Value of Lubrication Engineering to Management, by Mr. L. A. Darling, E. I. du Pont de Nemours & Co., Inc.

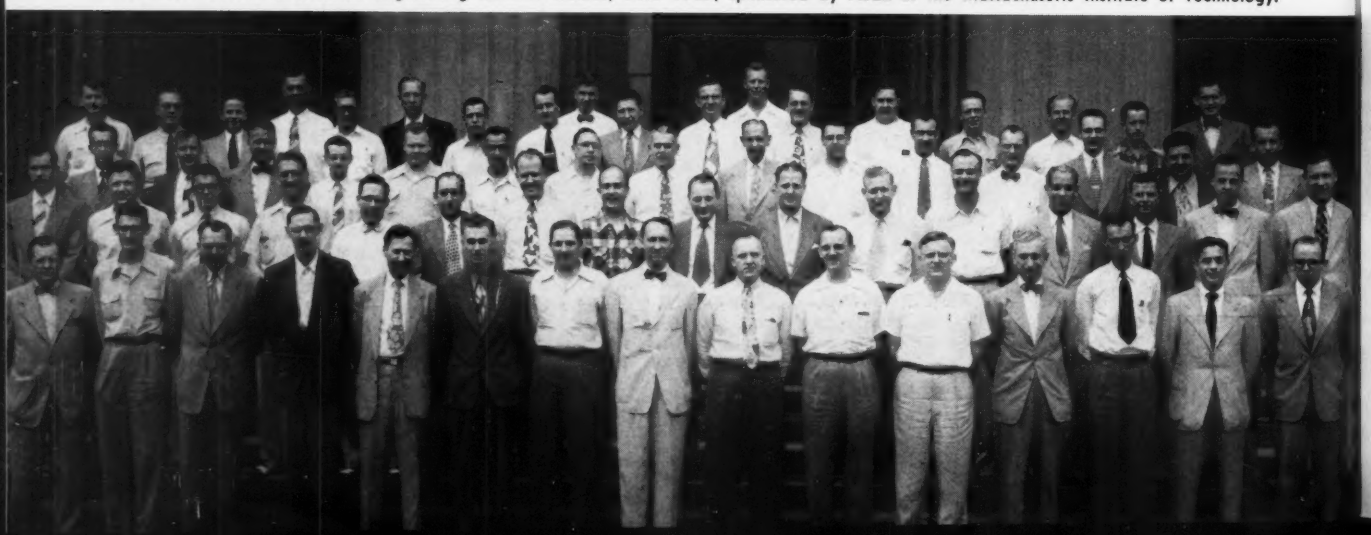
The 64 men who attended the Lubrication Engineering Summer Course have added a "first" to their other achievements. This educational accomplishment pioneers class instruction entirely devoted to the subject of lubrication.

Unfortunately, due to class limitations, it was impossible to accommodate even 50% of the applicants. Fifty of the 64 students represented industry, the balance, research and development fields.

Indicative of the widespread interest, geographically and industrially, an analysis of the attendance is presented:

Geographical:	24 states represented, ranging from Maine to California and Wisconsin to Texas.
Industrial:	Chemicals, Textiles, Rubber, Steel, Electrical, Bearings, Paper, Aircraft, Railroad, Instrument, Aluminum, Copper and Brass, Diesel, Machinery, Light and Heavy Manufacturing.
Occupational:	Engineers: Lubrication, Research, Plant, Mechanical, and Test; Chemists and other related professions.

Graduates of the Lubrication Engineering Summer Course, June 11-22, sponsored by ASLE at the Massachusetts Institute of Technology.



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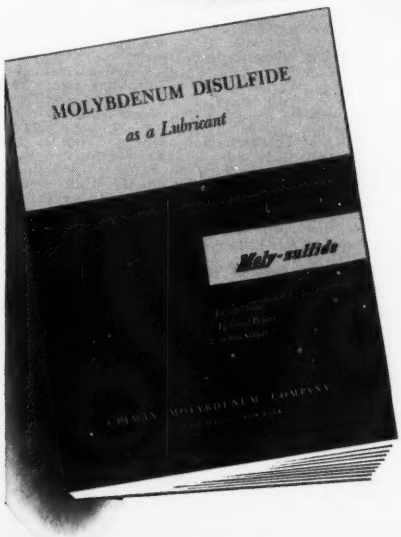

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OILS AND LUBRICANTS

PATENT ABSTRACTS

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 646, Nos. 1, 2, 3, 4, 5; Vol. 647, Nos. 1, 2, 3, 4.

PREPARED *by* ANN BURCHICK

Lubricating Compositions and Additives Therefor—Patent #2,551,124—William Helmore, assignor to C. C. Wakefield & Co,, Ltd.

A lubricating composition, which comprises, a mineral lubricating oil base in which is incorporated between 0.05% and 2% by weight of tin petroleum sulphonate and between 0.05% and 2% by weight of chromium petroleum sulphonate.

Stabilized Lubricants—Patent #2,551,525—Robert E. Burk and Everett C. Hughes, assignors to The Standard Oil Co.

A lubricant promoting combustion of deposits in the combustion zone of internal combustion engines and producing high stability in the crankcase, which comprises a lubricating oil and ¼ to 3% of the reaction product of phosphorus sulphide on cashew nut shell oil, and ½ to 3% of chromium napthenate.

Production of Lubricating Oils by Condensation of Olefinic Hydrocarbons—Patent #2,551,638—Francis M. Seger and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

The process for manufacturing a synthetic lubricating oil having a low pour point, a high viscosity index and high stability, which comprises contacting, in a reaction zone at a temperature falling within the range varying between about 50 C. and about 300 C., a charge consisting essentially of normal-alpha-monoolefinic hydrocarbons having between about seven and about twelve carbon atoms per molecule, with an organic peroxide in amounts of at least about 0.02 mole per mole of said normal-alpha-monoolefinic hydrocarbons, and for a period of time sufficient to effect condensation.

Synthetic Lubricants—Patent #2,551,640—Francis M. Seger, Charles F. Feasley and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

A viscous oil formed by: reacting a mixture consisting essentially of one molecular proportion of a halogenated olefin, from 0.5 to 1.5 molecular proportions of a normal alpha-monoolefin containing from about six to about eighteen carbon atoms, and from about 0.01 to 0.3 molecular proportion of an organic peroxide.

Synthetic Lubricants—Patent #2,551,642—William E. Garwood, Francis M. Seger, Charles F. Feasley and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

The process for effecting the condensation of a normal, alpha mono-olefin having from 5 to 18 carbon atoms, an aromatic hydrocarbon and an organic peroxide, which comprises: condensing said mono-olefin, aromatic hydrocarbon and peroxide at a temperature between about 50 C. and about 200 C. for a period of time sufficient to effect condensation, one molar proportion of said mono-olefin being so condensed with between about 0.1 and about 5 molar proportion of said aromatic hydrocarbon and with between about 0.01 and about 0.5 molar proportion of said peroxide.

Method of Preparing Synthetic Lubricants from Alpha Olefins—Patent #2,551,644—Francis M. Seger, William E. Garwood, and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

A method of preparation of a viscous oil characterized by low pour point, high viscosity index and high oxidation stability, which comprises: non-catalytically heating a hydrocarbon charge consisting essentially of a normal, alpha mono-olefin having from six to about twelve carbon atoms per molecule in the presence of a thiol, the molar ratio of said thiol to said olefin being from about 0.001 to about 0.1, at a temperature between about 300 F. and about 700 F.

Polysiloxane Grease and Method of Preparation — Patent #2,551,931 — Chester C. Currie, assignor to Dow Corning Corp.

A grease consisting essentially of a liquid organo polysiloxane having a degree of substitution of from 1.9 to 2.5 organic radicals per silicon atom, said radicals being selected from the group consisting of methyl, phenyl, and tolyl radicals and a minor amout of a metallic salt of an alicyclic substituted fatty acid in which fatty acid the chain length is from 2 to 6 carbon atoms, the metal of said salt being selected from the group consisting of alkali metals and alkaline earth metals, said salt being present in amount sufficient to form a grease.

Emulsion Concentrate of a Biological Toxicant—Patent #2,552,187—Milton Kosmin, assignor to Monsanto Chemical Co.

A water-dispersible concentrate for forming oil-in-water emulsions comprising an aromatic oil; a biological toxicant; from 3% to 10% by weight of an oil-soluble organic surface-active agent selected from the group consisting of sulfonates and sulfates and having a Draves wetting time of less than 10.5 seconds in an aqueous solution consisting of 0.5% by weight of said surface-active agent; and from 3% to 10% by weight of the condensation product of 1 mole of a C_6-C_{18} branched-chain aliphatic mercaptan with from 1 to 40 moles of ethylene oxide.

Lubricant Containing Ethers with Multiple Sulfur or Like Linkages—Patent #2,552,510—George E. Barker and George E. Alter, Jr., assignors to Elgin National Watch Co.

A lubricant in which the lubricating base is diamyl-dithio-dialkyl sulfides as a mixture of isomers, the said alkyl groups having a chain of 2 to 7 carbon atoms, said lubricant being characterized in having a viscosity at 100 F. of substantially 6.5 to 12.8 centistokes, a viscosity at 32 F. of substantially 23.3 to 46.3 centistokes, and cloud and pour points below minus 100 F.

Emulsifying Agent, Method of Making Said Emulsifying Agent, and Water-In-Oil Emulsion Using Said Emulsifying Agent — Patent #2,552,706—Simon H. Bertram, assignor to Fredrik Andre Moller.

An emulsifying agent that produces excellent heat-resistant emulsions of the water-in-oil type, comprising an oil soluble but substantially water insoluble nonresinous reaction product of the heating together in any order of a low molecular polyhydric alcohol, a higher fatty acid and an aliphatic polycarboxylic acid until the interaction thereof has proceeded to a stage at which the reaction product has emulsifying powers such that upon subjecting 20 cc. of a 0.25% solution thereof in neutral, freshly refined ground nut oil to the "steam emulsion test" the time required for separation of 5 cc. of the oil is at least 20 mnutes.

Soluble Oil—Patent #2,552,913—Stanley P. Waugh, assignor to Tide Water Associated Oil Co.

A stable soluble oil composition comprising a mineral oil, about 5 to about 50% based on the weight of said composition of an extreme pressure agent from the group consisting of sulfur-containing, phosphorus-containing and chlorine-containing extreme pressure agents for said mineral oil, a water-soluble soap as an emulsifying agent, water in an amount sufficient to inhibit said composition against gelation but less than an amount sufficient to induce separation of said composition, about 0.3 to about 3% of a polyhydroxy alcohol and an amount of an alcohol-ether of from about one to about five times that of the poly-hydroxy alcohol, the total amount of soap being less than the amount of extreme pressure agent but sufficient to stabilize the composition against separation.

Fuel Oil Composition—Patent #2,553,183—John B. R. Caron, Calmy Wies, and Everett B. Glendenning, assignors to Shell Development Co.

A non-clogging fuel oil containing entrained moisture and normally susceptible to cause clogging containing in combination therewith from about 0.0025% to about 0.005% of 1-aminoethyl-2-heptadecenyl glyoxalidine.

Sulfonate Grease—Patent #2,553,422—Rosemary O'Halloran, assignor to Standard Oil Development Co.

A great composition comprising a lubricating oil and from 10 to 30% by weight of a complex addition product of an oil soluble alkaline earth metal petroleum sulfonate and an alkaline earth metal salt of an acid selected from the group consisting of low molecular weight carboxylic acids, said complex addition product being formed of from 28 to 55% by weight of said acid salt with about 45 to 72% by weight of the said oil soluble sulfonate.

Lubricating Grease Composition—Patent #2,553,423—William W. Shepard, assignor to Standard Oil Development Co.

A lubricating grease composition comprising a lubricating oil and a sufficient quantity of a mixture of substantially equal parts of metal sulfonates of at least two sulfonic acids having, respectively, a molecular weight of 420 to 500 and a molecular weight of 350 to 380, combined in a complex with a salt of an acid selected from the group consisting of low molecular weight aliphatic carboxylic acids, to thicken said oil to a grease consistency.

Preparation of Metallic Derivatives of the Reaction Products of Phosphorus Sulfide and Esters or Amines by the Use of Metal Cyanamides—Patent #2,553,586—Everett C. Hughes and John D. Bartleson, assignors to The Standard Oil Co.

In the process of preparing calcium-containing derivatives of oil-dispersible reaction products of a phosphorus sulfide and an organic compound reactive with phosphorus sulfide and selected from the group consisting of amines and esters reactive with phosphorus sulfide, the improvement which comprises reacting said reaction product with 0.25 to 6.0 equivalents of calcium cyanamide per mol of the phosporus sulfide in said reaction product at a temperature in the range of 300 F. to 700 F. to provide an oil-dispersible ash-forming calcium-containing final reaction product for use as a lubricant and as an additive for lubricants to improve their characteristics.

Preparation of Metallic Derivatives of the Reaction Products of Phosphorus Sulfide and Esters or Amines by the Use of Metal Carbides—Patent #2,553,587—Everett C. Hughes and John D. Bartleson, assignors to The Standard Oil Co.

In the process of preparing calcium-containing derivatives of oil dispersible reaction products of a phosphorus sulfide and an organic compound reactive with phosphorus sulfide and selected from the group consisting of amines and esters reactive with phosphorus sulfide, the improvement which comprises reacting said reaction produce with 0.25 to 6.0 equivalents of calcium carbide per mol of the phosphorus sulfide in said reaction product at a temperature in the range of 300 F. to 700 F. to provide an oil-dispersible ash-forming calcium-containing final reaction

(*Continued on page* 203)

Wire Rope Lubricants and Lubrication

(*Continued from page* 181)

pressure type grease by means of a paddle or brush to the outer surfaces of a wire rope. These materials and this method of application offer no more than a slight degree of protection to the outer surfaces of the rope only. For ropes whose service life is no more than a few weeks or at best a few months such practice is, however, better than nothing. Still other users of wire rope apply a light engine oil to their ropes. This material will usually penetrate to the core and does offer some protection to the core but has practically no value as a lubricant or corrosion protective agent to the balance of the rope.

The foregoing is, of necessity, general in nature and is set forth chiefly to emphasize the importance of re-lubrication of wire rope in service. The most efficient method of re-lubrication and the most suitable lubricating material will depend on the conditions surrounding each wire rope application. Treatment of elevator ropes has not been discussed because this class of wire ropes require special attention beyond the scope of this paper.

There are, of course, many other causes of premature wire rope failure in addition to improper or insufficient lubrication, such as poor sheave design, improper sheave arrangement, faulty sheave maintenance, kinking of the wire rope, improper running-in practices, overloading, careless handling and storage, etc. All of these factors together with lubrication are important. If each is given proper attention and wire rope is applied, maintained, and regarded as a precision machine, it will give the efficient and economical service for which it is designed.

Just because gravy goes swell over noodles, he shouldn't assume it's good on hair, too!

And just because one bearing is best lubricated by one particular grade of oil, you shouldn't assume that the same oil is best for *all* bearings on that machine. In many cases it isn't.

OIL CUPS permit you to lubricate each bearing with the oil best suited to that bearing—thus prolonging bearing life, reducing maintenance costs, cutting down-time, boosting production. And oil cups fortunately *cost very little.*

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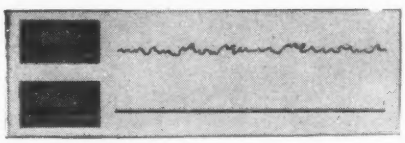
FOR LUBRICATING OPEN GEARS

4 GRAM TEST PROVES *Klingfast* BEST!

A major steel company examined a total of five lubricants in which 4 grams of each were tested. It was a laboratory experiment designed to approximate lubrication conditions for open gears and sleeve bearings. The results showed that Leadolene* Klingfast *gave almost three times the service of the next best lubricant, and up to five times the service of other lubricants tested.* All lubricants considered were of quality nature, and are widely used in open gear service.



Lower project line indicates safe lubrication as was the case with Leadolene Klingfast through the entire test. Upper project line indicates scoring.

To conduct the 4-Gram Test the steel company made certain alterations in the Timken Testing Machine, long considered standard for determining the breakdown point of lubricants. First the flow of lubricant to the ground steel block and cup was shut off. Then four grams of the lubricant being tested were applied at room temperature. The machine was watched closely and timed for scoring. In this way open gear and sleeve bearing lubrication conditions were reproduced for laboratory study.

The results of the 4-Gram Test are typical of the service Leadolene Klingfast will give you in actual use. *May we send details and a generous sample for your own testing?*

RESULTS
of 4-Gram Test

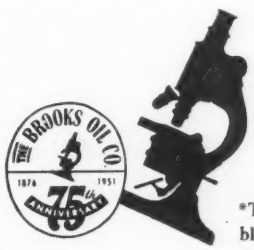
KLINGFAST . . . 30 minutes without scoring or failing.

LUBRICANT A . . . Failure: 12 minutes. Scored in 5 minutes.

LUBRICANT B . . . Failure: 8 minutes.

LUBRICANT C . . . Failure: 6 minutes.

LUBRICANT D . . . Failure: 6 minutes.



*The "I. P. Lubricant" (Indestructible pH-ilm) . . . for industrial needs.

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Now—One grease will service all grease applications in the majority of plants

Gives ALL THESE PLANT SAVINGS:

1. **Extends TIME between greasings**—lasts longer . . . stays in bearings longer.
2. **Low-cost application**—fewer servicings and *only the one grease* to handle.
3. **Simple inventory**—Shell Alvania Grease replaces up to 20 brands formerly required.
4. **Better protection**—against heat, cold and moisture.
5. **Greater safety**—less chance of applying the wrong grease!

Gives ALL THESE LUBRICATION ADVANTAGES:

1. **Higher mechanical stability** than any conventional grease at operating temperatures.
2. **Pumpable at low temperatures**—even in unheated storage.
3. **Stable at high temperatures**—superior to the best "soda" greases.
4. **Impervious to water**—excellent resistance to washing out.
5. **Longer service life**—reduced consumption.

The "MILLION-STROKE" Industrial Grease!

A grease that will stand 100,000 punishing strokes of the ASTM Work Tester has been considered a superior lubricant.

In a deliberate attempt to break down Shell Alvania Grease, *on the same tester* the run was extended...200,000 strokes...300,000 strokes . . . 500,000 strokes! Finally, at one million strokes the test was discontinued, because this grease *would not break down*—it was still a fit lubricant both in appearance and consistency.

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SHELL ALVANIA . . . The "MILLION STROKE" Grease

USED OIL made LIKE NEW at LOW COST

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Models for 25 to 600 g.p.h. requirements

Longer life for your oil investment! *Without the* high maintenance cost of centrifuges, the Hoffman Oil Conditioner removes both soluble and insoluble impurities completely. Models to meet your requirements, from 25 to 600 g.p.h. Unit consists of Hoffman Cartridge Filter and Hoffman Vaporizer . . . mounted on a common base . . . may be operated separately or together. Only two moving parts. Complete with all necessary electric and pipe connections.

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SECTION NEWS

(*Continued from page* 182)

Mr. Bisson has done excellent work with NACA at the Flight Propulsion Laboratory in Cleveland. According to Mr. Bisson, an experimental investigation was conducted to identify roles of solid-surface films in the various mechanisms of sliding and lubrication involved in the mating and compatability of boundary-lubricated slider surfaces, in the action of extreme-pressure lubricants, and in the operation of slider surfaces not supplied with fluid lubricants.

Molybdenum disulfide MoS_2 was very effective in reducing friction at high sliding velocities. This film material was very tenacious, chemically and thermally stable and consequently should have many practical applications. Mr. Bisson demonstrated with slide schematic diagrams of the sliding-friction apparatus; charts showing the effect of sliding velocity on friction for surfaces with solid films of Molybdenum disulphide MoS_2 and oriented graphite C and photomicrographs of wear areas on SAE 1020 steel discs having dry lubricating films.

BOSTON

By A. S. McNeilly, Secretary

"Grease Lubrication of Integral Sealed and Shielded Ball Bearings," by Dr. Leland D. Cobb, Mgr. of Research and Development, New Departure, Div. GMC, Bristol, Conn. —May meeting.

Ed. Note: An abstract or the complete paper will be published in one of our forthcoming issues.

CURRENT LITERATURE

(*Continued from page* 188)

TESTING HIGH TEMPERATURE LUBRICANTS

Anon.—p. 95

(Industrial Laboratories, Vol. 1, No. 2, Nov. 1950, p. 26)

A long-range research project to evaluate lubricating oils used in industrial applications where they are subjected to high temperatures has been conducted by E. F. Houghton Company. In an 18-month study reported in the firm publication, The Houghton Line, conditions encountered in industrial lubricating oil uses such as in kilns, drying ovens, furnaces and heat tunnels, were duplicated in more than 150 separate tests. Oils were subjected to temperatures of 400, 450 and 500 degrees C.

LUBRICATING OIL RECOMMENDATIONS FOR SLOW AND MEDIUM SPEED DIESEL ENGINES

OUR COVER

The first permanent white settlers came to the area now known as Buffalo, then called New Amsterdam, in 1784. When the war of 1812 was declared Buffalo was a community of log cabins with a population of 1500. After almost complete destruction by enemy invasion and fire, the settlement was reestablished and incorporated as the Village of Buffalo in 1816. With the opening of the Erie Canal in 1825 the city's growth as a great center of commerce began.

Buffalo is the second largest city in New York State in population and the fifteenth in size of the Nation. It has a high diversification of industries, having both light and heavy manufacturing. It is the center of one of the largest electro-chemical and electro-metallurgical production areas in the world. Since 1914, when the Curtiss-Wright Airplane Company located in Buffalo, the city has held a leading position in the aeronautical world and is now the headquarters of the Bell Aircraft Corporation and the Cornell Aeronautical Laboratory.

Buffalo is the largest inland water port in the United States in value of water-borne commerce handled.

In the heart of the world-famous Niagara Region and at the gateway to Canada, Buffalo is the hub of the greatest industrial and commercial activity on the North American continent.

The city presents a panorama of industrial enterprise and diversified achievement. The activity in its harbor and railroad terminals at the crossroads of international commerce — the towering grain elevators — big steel plants — airplane manufacturers and scores of other diversified industry and commercial activities provide a scene of American industry and commerce at its best.

Buffalo, "The City of Good Neighbors," abounds with interesting things to see and entertaining things to do.

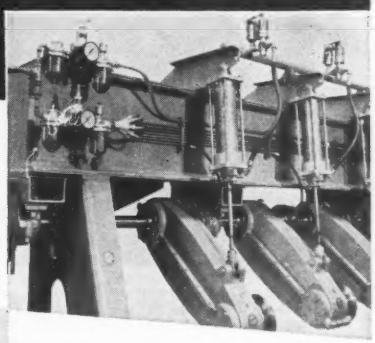
NORGREN *Micro-Fog on Portland Overhead Trimmer*

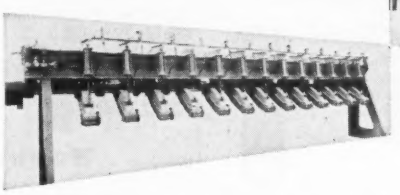
Lubricates Bearings & Drives

on 24-ft. assembly of 13 saw ladders

Results after gruelling saw mill service...

1. Bearings in excellent condition
2. Chain drives and sprockets show no sign of excessive wear
3. NO ACCUMULATION OF OIL IN HOUSINGS





Note Norgren Lubro-Control units—upper one serving six ladders at far right, lower one serving seven ladders on near end of trimmer. Note oil-fog distributor and take-offs to each ladder above right.

The PORTLAND OVERHEAD TRIMMER product of Portland Iron Works, Portland, Ore., manifolds an oil-fog to 13 saw ladders over distances up to approximately 24 feet. After gruelling sawmill service, each set of bearings, chain drives, and sprockets showed faultless lubrication. An engineering problem was solved by avoiding oil pools in ladder housings.

For full details, write for APPLICATION DATA SHEET No. 109—C. A. Norgren Co., 237 Santa Fe Drive, Denver 9, Colo.

25th Year of Progress

NORGREN MICRO-FOG LUBRICATION *is recommended by leading manufacturers of portable pneumatic sanders. Ends danger of oil-staining the wood.*

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Lubricators, Regulators, Filters, Relief Valves, Check Valves, Air Governors, Needle Valves, Hose Assemblies and Couplings.

25 YEARS OF HELPING AIR POWER SERVE INDUSTRY BETTER

Anon.—p. 102

(Service Factor, Vol. 15, Second Edition, pp. 1-5, 1950)

Generally, for slow and many medium speed engines a well refined straight mineral oil is satisfactory, although for some combinations of operating conditions, a Heavy Duty Type oil is needed for best performance. A chart of recommended or preferred Sinclair diesel lubricating oils is given. This tabulation reflects the thinking of the engine builders with respect to types of oil considered best suited for the respective engines, but is expressed in terms of Sinclair brand names. Sinclair diesel oils, Rubilene, Gascon oil and Rubilene oil HD and Gascon oil HD are taken up.

ANNUAL CONVENTION OF AMERICAN SOCIETY OF LUBRICATION ENGINEERS, 1951

PLANNED LUBRICATION IN IBM
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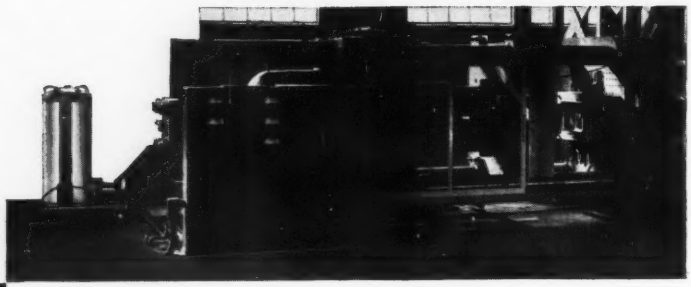
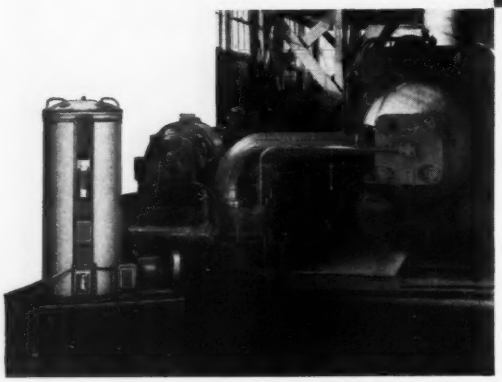
WIRE ROPE LUBRICANTS AND LUBRICATION
Critchlow, J. P. and Flynn, R. W.—p. 67

world's largest injection molding press





● This 69-ton, 300-ounce Watson-Stillman press accommodates dies up to 72" x 48". One of 14 injection molding machines at Amos Molded Plastics, Edinburg, Indiana, it employs a 7½-ton, 550 gallon hydraulic oil pumping unit (shown above being serviced by Honan-Crane Oil Purifier). Hydraulic equipment at Amos Plastics has been protected by Honan-Crane Purifiers since 1942.

gets Honan-Crane Hydraulic Oil Purification

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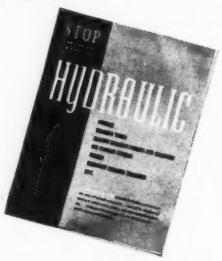

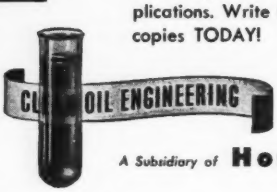

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EVALUATION OF LUBRICATING PROPERTIES OF DRAWING COMPOUNDS
Wojtowicz, W. J.—p. 67
AUTOMOTIVE DRAWING COMPOUNDS CHARACTERISTICS AND APPLICATION
O'Reilly, J. T.—p. 67

***National Petroleum News*, Vol. 43, No. 15, April 11, 1951**

LUBE MEN SEE NO 'MAGIC' IN NON-PETROLEUM OIL

Ridder, H.—pp. 63-65

To obtain a cross section of what oil industry lube men have to say about Carbide & Carbon Chemical Corp.'s Prestone motor oil, *National Petroleum News* made a survey. Results of the survey indicate the lube men feel that this synthetic oil will not solve the hydraulic valve lifter problem. Because Prestone motor oil is being sold to a "select" market at a price of about 2½ times that for high quality petroleum oils, lube men do not consider the product a serious competitor to conventional high quality motor oils.

FEDERAL TRADE COMMISSION CHARGES COMPANY'S CANS AREN'T LABELED RECLAIMED OIL

Anon.—p. 52

In complaint issued against Pennsylvania Oil Terminal, Inc., Silver Hill, Md., Federal Trade Commission charged that use of the abbreviation "Pen" in brand name "Penolube" and use of word "Pennsylvania" in corporate name constitutes misrepresentation that product is refined and processed entirely from oil produced in Pennsylvania field.

No. 19, May 9, 1951

HOLMAN SAYS SYNTHETIC OIL IS NOT NEEDED AT PRESENT

Anon.—p. 21

Eugene Holman, President of Standard Oil Co. (N. J.) told Empire Club, at Toronto, Canada, he saw "no reason to begin production of synthetic fuel on a commercial scale in the U. S. at present." There are ample petroleum supplies.

API ASKS COMMERCE TO MAKE LUBES-GREASE SALES SURVEY

Anon.—p. 24

API is going to ask Commerce Department's Office of Domestic Commerce to make a second survey, with API funds, of a year's sales of lubricating oils and greases, such as was made for 1947. 1950 is to be covered. Sales by states and types of products are to be shown.

No. 22, May 30, 1951

FUELS, LUBRICANTS PROJECT LAUNCHED BY NAVY ENGINEERS

Anon.—p. 60

A six-phase new fuels and lubricants project has been established at U.S. Naval Engineering Experiment Station, Annapolis, Md. They are: 1—Brand approval tests of aircraft engine oils, turbine oils, Diesel engine oils and thin film rust preventatives. 2—Application of high quality lubricating oils to Diesel engines to allow better operation under submarine snorkel conditions and to mitigate the effect of large amounts of sulphur present. 3—Improvement of lubricating oils for winter operation. 4—Development of fuel type starting aids. 5—Development of new marine gas turbine fuels. 6—Development of new lubricants which will allow satisfactory operation of the latest types of marine reduction gears.

***Oil and Gas Journal*, Vol. 49, No. 48, April 5, 1951**

MULTIPURPOSE GREASES

Anon.—p. 109

The newer, "multipurpose" greases are so called because they combine in a single product the more desirable characteristics normally found in each of several products. Such greases will undoubtedly be improved. Importance of barium soap greases has increased rapidly. They have high melting points (about 350 F.), and can be successfully used at temperatures 75° to 100° higher than the corresponding older-type sodium soap products. Greases containing lithium soaps give great promise of becoming highly valuable multipurpose lubricants.

No. 51 (Geological Number), April 26, 1951

ADDITIVES PROBLEM

Anon.—p. 69

The subject of additives for lubricating oils was explored by speakers at a technical session of the National Petroleum Association's semi-annual meeting April

(*Continued on page* 202)

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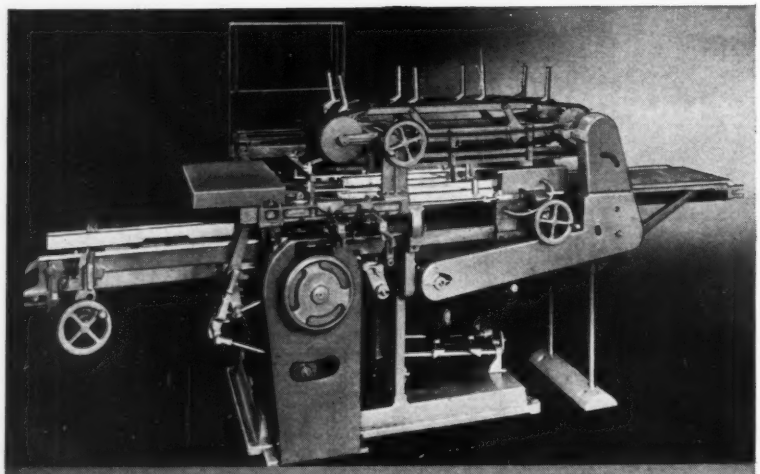

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(*Continued from page* 200)

20 in Cleveland. Some highlights of the papers: 1—The 1951 requirements for additives are up substantially, and a short supply is in prospect. 2—The argument that it is more economical to use a high-additive oil than to refine further the fuel is questionable in the view of the military. 3—High-detergency oils are not a cure-all for light-duty engine problems.

ADDITIVES AND OTHER FACTORS THAT INFLUENCE GREASE CHARACTERISTICS

Anon.—p. 199

Two factors which influence grease properties are chemical additives used and percentage of soap employed. Each is considered.

SOLVAY DETERGENT OUTPUT

Anon.—p. 206

Information on the new detergent Nytron, product of Solvay Process Division, Allied Chemical & Dye Corp., has been released. A thermal cracking unit at the Hopewell, Va., plant charges petrolatum, and pressure and temperature conditions are maintained to produce a maximum of light olefins. After separation, these basic olefins are then reacted with nitrosyl chloride for production of the finished detergent.

Vol. 50, No. 2, May 17, 1951

GREASE APPLICATIONS

Anon.—p. 143

Certain factors in machine design and operation are responsible for the "consumer demands" which lubricating greases must meet. These include the load-speed relation, type of motion exerted, operating temperature, accessibility, and possibility of contamination. The three characteristics of greases which combine in various ways to meet widely divergent demands are plastic consistency, directional fluidity, and film polarity.

No. 3, May 24, 1951

MORE ON GREASE APPLICATIONS

Anon.—p. 147

The stayput ability of greases permits the interval method of application. Their directional fluidity allows them to serve as excellent lubricants and also permits them to be pumped in centralized systems through supply lines of small diameter. The polar characteristics of grease enable it to form and maintain a tightly adhering lubricating film which prevents metal-to-metal contact of such sliding surfaces.

Oil, Paint and Drug Reporter, Vol. 159, No. 19, May, 1951

SYNTHETIC LUBRICANT OILS STUDIES OF FARBEN TOLD

Anon.—p. 49

The development of synthetic lubricant oils by Germany's I. G. Farben is reviewed in a new report now available from the Office of Technical Services. PB-101,870, "Studies on Synthetic Lubricant Oils," twelve pages including tables, sells for 50 cents per copy. Orders should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C.

PATENT ABSTRACTS

(*Continued from page* 194)

product for use as a lubricant and as an additive for lubricants to improve their characteristics.

Mineral Oil Lubricant Containing Alkyl Ketone-P_2S_5 Reaction Product—Patent #2,553,588—Everett C. Hughes, assignor to The Standard Oil Co.

The reaction product of an alkyl ketone having at least 12 carbon atoms with 0.1 to 2.0 moles of a sulfide of phosprous per mole of the ketone, reacted at a temperature of about 500 F. to produce an oil-dispersible reaction product suitable for improving the stability of lubricating oil against oxidation.

Water-Soluble Lubricant of Polyethylene Glycol and a Sulfonate—Patent #2,553,601—Franklin Veatch and John G. Partch, assignor to The Standard Oil Co.

A water soluble composition consisting essentially of about one part by weight of a water soluble surface active sulfonate and an amount within the range of about 2 to about 100 parts by weight of a polyethylene glycol having an average molecular weight within the range of from about 2000 to about 8000 to form a composition which is adapted to be added to water to provide an improved metal cutting fluid.

Lubricants—Patent #2,554,222—Fred H. Stross—assignor to Shell Development Co.

A lubricating composition comprising a liquid oleaginous material, a hydrophilic inorganic gel in an amount to at least thicken said oleaginous material, and a minor amount, based on the weight of the gel, of a hydrophobic cationic surface-active agent, said agent being present in an amount to substantially improve the water resistance of said composition, said composition being characterized by the fact that the structure of the inorganic gel therein is substantially that of the gel as originally formed.

Lubricating Oil Manufacture—Patent #2,554,282—Alexis Voorhies, Jr., assignor to Standard Oil Development Co.

The method of upgrading a lubricating oil stock which consists essentially in subjecting said stock to the influence of hydrogen and mild hydrogenation conditions of temperature and pressure in the presence of a catalyst which consists essentially of a mixture of two mols of nickel sulfide and one mol of tungsten sulfide for a sufficient period of time to effect the conversion of a major portion of said stock to a lubricating oil of improved viscosity index and thereafter recovering said improved lubricating oil.

Lubricant Manufacture—Patent #2,554,395—William N. Axe, assignor to Phillips Petroleum Co.

A process for the manufacture of a lubricating oil from an extract oil including most of any naphthenes, aromatics, and asphalts obtained by solvent refining of a lubricating Mid-Continent oil stock, which comprises dissolving said extract oil in a paraffinic hydrocarbon solvent containing at least 5 and not more than 10 carbon atoms per molecule in a volume ratio of solvent to oil in the range of 0.25:1 to 5:1, passing the resulting solution to an alkylation zone maintained at an alkylation temperature in the range of 100 F. to 200 F., introducing into said alkylation zone a straight-chain 1-olefin having at least 8 and not more than 20 carbon atoms per molecule and a liquid alkylation catalyst, mixing the total contents of said alkylation zone, maintaining the resulting reaction mixture in said alkylation zone for a period of time of from 30 to 100 minutes, passing the reaction mixture effluent from said alkylation zone to a separation zone where said reaction mixture is separated into a catalyst phase and a hydrocarbon phase, and recovering a lubricating oil from said hydrocarbon phase.

Aluminum Soap Compositions and Greases Containing Them — Patent #2,555,104 — Kenneth D. Ashley and Scott Mason, assignors to American Cynamid Co.

A grease composition comprising a major proportion of a hydrocarbon lubricating oil and a minor quantity within the range of 1% to 20% by weight of the aluminum salt of a mixture of about 4% to 8% by weight of dimerized poly-unsaturated fatty acids of 18 carbon atoms and about 96% to 92% of monomeric saturated fatty acid of 12-22 carbon atoms together with from 1% to 8% of glycerine based on the weight of said aluminum salt.

Polyamide Resin from Dimerized Unsaturated Fatty Acids of Natural Fatty Oils —Patent #2,555,111—Theodore F. Bradley, assignor to Shell Development Co.

The resinous polyamide of (1) dimerized olefinically unsaturated fatty acid of natural fatty oil, which fatty acid contains 16 to 22 carbon atoms, and (2) a saturated aliphatic diamine having two primary amino groups, one of which is linked directly to a tertiary carbon atom.

Wire Rope Lubricant—Patent #2,556,289 —Arnold J. Morway and John C. Zimmer, assignors to Standard Oil Development Co.

A lubricating composition consisting essentially of about 6 to 13% by weight of lithium soap of substantially saturated fatty acids within the C_{12} to C_{22} range, 0.5% to 1% of an amphoteric metal naphthenate as a structure stabilizer, 0.25% to 0.5% phenyl alpha naphthylamine, 1 to 5% oil-soluble sodium petroleum sulfonate, 1 to 5% degras, 3.75 to 10.0% non-corrosive sulfurized sperm oil and about 65 to 87.5% of a mineral base lubricating oil.

Stabilization of Edible Fats and Oils—Patent #2,557,921—Joseph A. Chenicek and Wm. K. T. Gleim, assignors to Universal Oil Products Co.

A method of stabilizing edible fats and oils against rancidity which comprises adding thereto a hexahydroxy-p-terphenyl having two hydroxy radicals on each of the phenyl rings.

Refining of Lubricating Oils — Patent #2,557,940—Paul H. Carnell, assignor to Phillips Petroleum Co.

The process of improving the properties of a lubricating oil which comprises treating said oil with substantially anhydrous hydrofluoric acid and an isoparaffin at elevated temperatures and pressure in a first step, cooling the treated mixture, adding and thoroughly admixing a phenolic compound with the cooled mixture in a second step to extract said oil and thereby improve its color, separating the admixture into an acid phase containing said acid and said phenolic compound and a hydrocarbon phase, and distilling said hydrocarbon phase to recover said improved lubricating oil.

Process of Removing Mineral Oil from Vegetable Fibers — Patent #2,557,993 — Ralph R. Oliver, assignor to Lockport Cotton Batting Co.

A process of removing mineral oil from vegetable fibers contaminated therewith which includes the steps of subjecting the fibrous material while the same contains at least 45% of water based on the dry weight of the fibers, to currents of air heated to temperatures between 120 C. and 160 C. to volatilize mineral oil and some of the water of the fibrous material, said treatment being continued until the water content of the fibrous material is approximately 30%, then subjecting the fibrous material to air currents heated to approximately 90 C. to 120 C. until the water content of the fibrous material is reduced to about 15%, and then further drying the fibrous material at temperatures well below the boiling point of water to reduce the moisture content thereof.

Non-Inflammable Hydraulic Fluids and Lubricants—Patent #2,558,030—William A. Zisman, Dwight R. Spessard, and Jacques G. O'Rear.

A non-inflammable hydraulic fluid consisting essentially of from about 30% to about 50% by weight water, from about 30% to about 55% by weight of a freezing point depressant selected from the group consisting of glycols and glycol ethers having from 2 to 14 carbon atoms, from about 4.5% to about 25% by weight of a polyalkylene glycol copolymer having an average molecular weight of from about 15,000 to about 20,000, from about 0.7% to about 2% by weight of diamylammonium laurate, from about 0.3% to about 15% by weight ethylene glycol monobutyl ether, from about 1% to about 2% by weight of a vapor phase inhibitor selected from the group consisting of diisopropyl ammonium nitrite, diisobutyl ammonium nitrite and dicyclohexyl ammonium nitrite, from about 0.1% to about 0.3% by weight of sodium mercaptobenzothiazole and from about 0.1% to about 1% by weight of salicylalethanomaline.

Mineral Lubricating Oil Containing Chlorinated Hydrocarbons—Patent #2,558,079—Benjamin Gallsworthy, assignor, by mesne assignments, to The Texas Company.

A high pressure lubricant comprising a mixture of a petroleum hydrocarbon lubricating oil having a viscosity of about 50 seconds Saybolt Universal at 210 F. and containing in the neighborhood of 5% combined chlorine and a petroleum hydrocarbon lubricating oil having a viscosity of about 800 seconds Saybolt Universal at 210 F.

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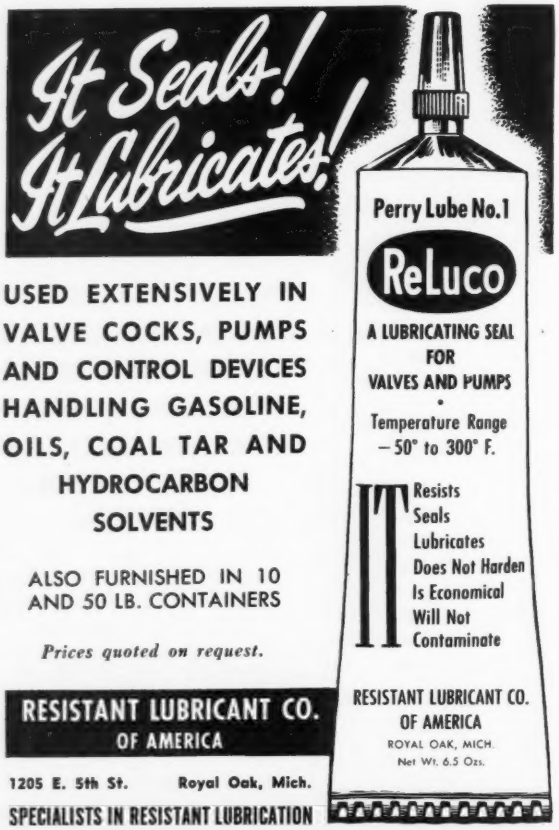

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Farval system on crusher pays for itself in 4 months

IN March, 1949, a Farval Automatic Lubrication System was installed on this Fairmount roll crusher in an eastern cement plant. Noteworthy savings were evident immediately — in grease consumption, oiling labor and bearing expense.

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FARVAL—*Studies in Centralized Lubrication*
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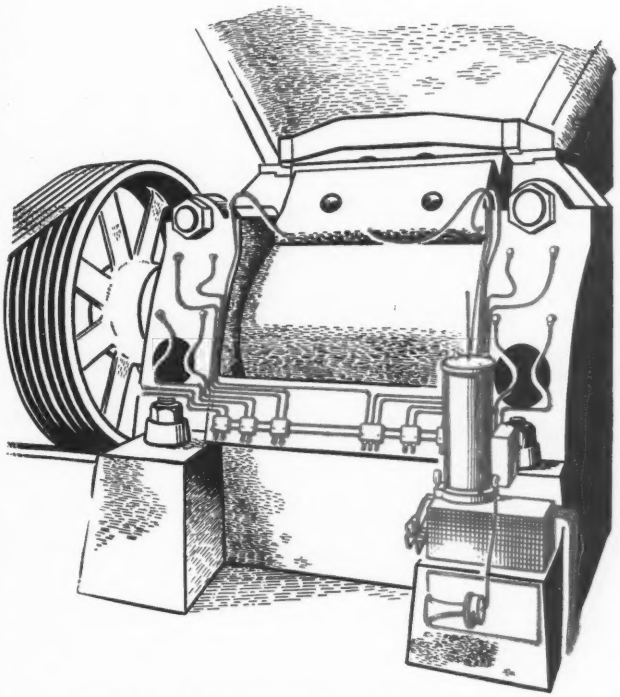

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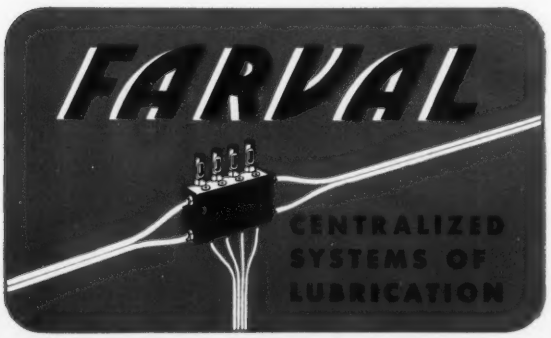

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